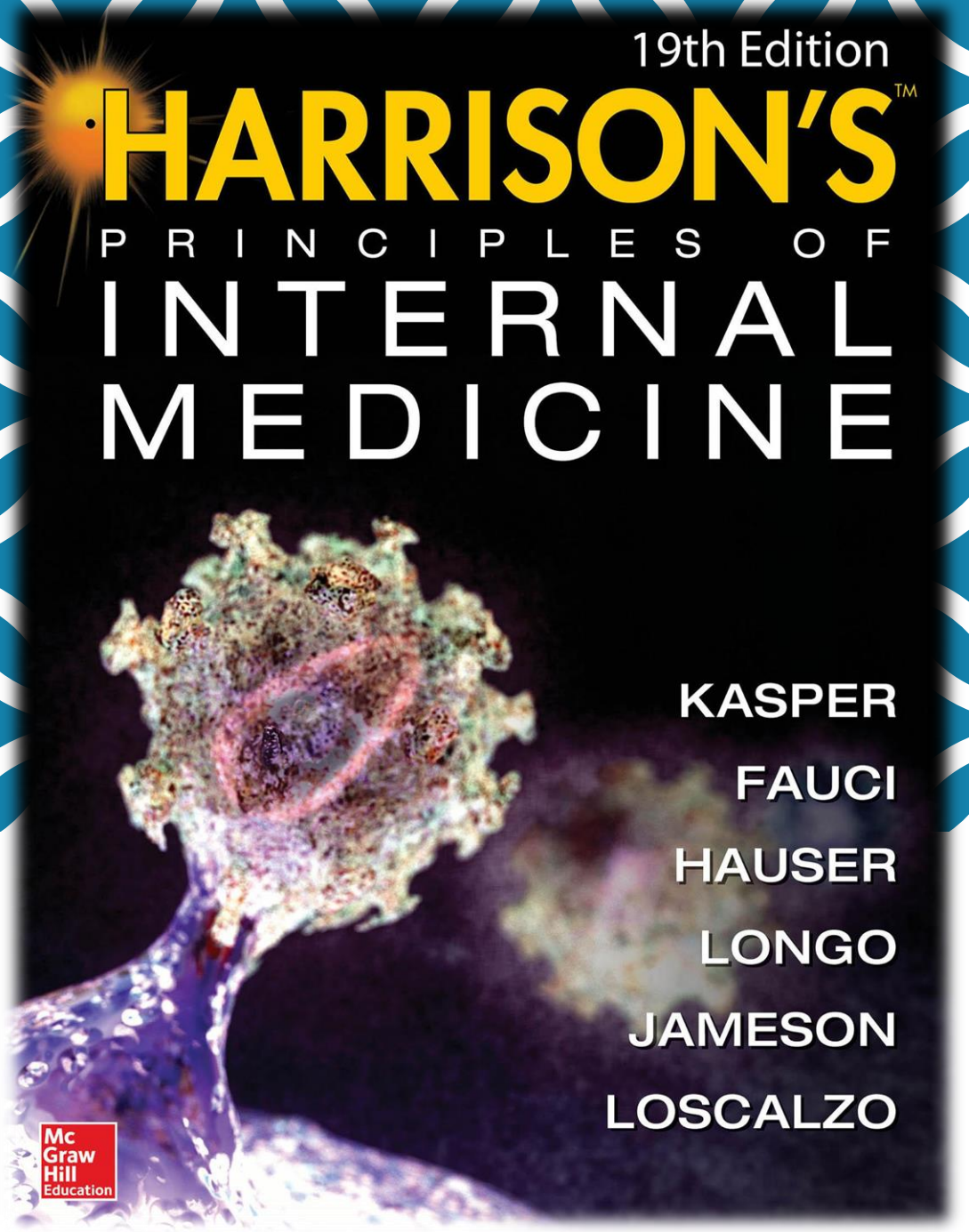
PNEUMONIA


19th Edition
HARRISON'S
PRINCIPLES OF
INTERNAL
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Education

Pneumonia DEFINITION

- Pneumonia is an infection of the pulmonary parenchyma.
- Despite being the cause of significant morbidity and mortality
  - Misdiagnosed
  - Mistreated
  - Underestimated

Community acquired pneumonia (CAP)

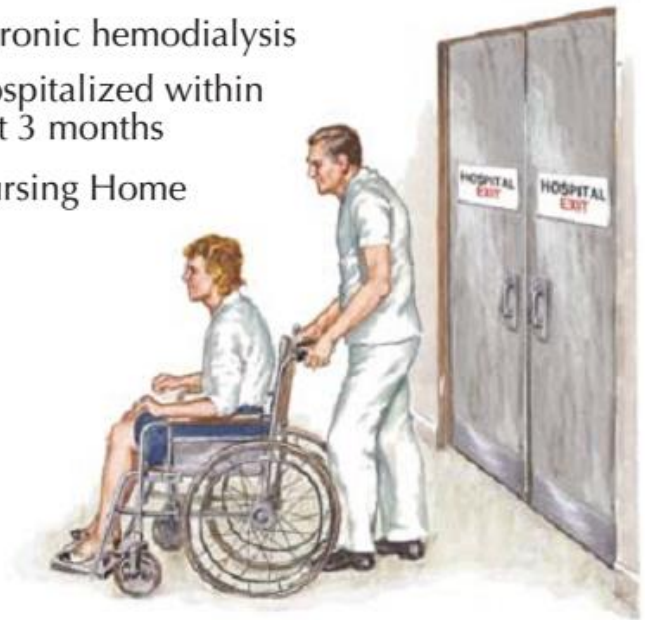
Hospital acquired pneumonia (HAP)

Healthcare-associated pneumonia (HCAP)

Chronic hemodialysis

Hospitalized within last 3 months

Nursing Home



Ventilator-associated pneumonia (VAP)

HCAP

- pneumonia as outpatients
- multidrug-resistant (MDR) pathogens previously associated with HAP.
- risk factors for infection with MRSA independent of other MDR

CAP MDR pathogens;

- at least two, risk factors
- probability of drug resistant pathogens
- initial empirical broadspectrum antibiotic therapy

Risk Factors for Pathogens Resistant to Usual Therapy for CAP

- MULTIDRUG-RESISTANT GRAM-NEGATIVE BACTERIA AND MRSA
- Hospitalization ≥2 days in previous 90 days
- Use of antibiotics in previous 90 days
- Immunosuppression
- Nonambulatory status
- Tube feedings
- Gastric acid suppression
- Severe COPD or bronchiectasis

Risk Factors for Pathogens Resistant to Usual Therapy for CAP

- NOSOCOMIAL MRSA
- Hospitalization ≥2 days in previous 90 days
- Use of antibiotics in previous 90 days
- Chronic hemodialysis in previous 30 days
- Documented prior MRSA colonization
- Congestive heart failure
- Gastric acid suppression

Risk Factors for Pathogens Resistant to Usual Therapy for CAP

- COMMUNITY-ACQUIRED MRSA
- Cavitary infiltrate or necrosis
- Gross hemoptysis
- Neutropenia
- Erythematous rash
- Concurrent influenza
- Young, previously healthy status
- Summer-month onset

Causes :

proliferation of microbial pathogens at the alveolar level

host's response to those pathogens

Routes :

1- Oropharygeal aspiration (aged & loss of consciousness)

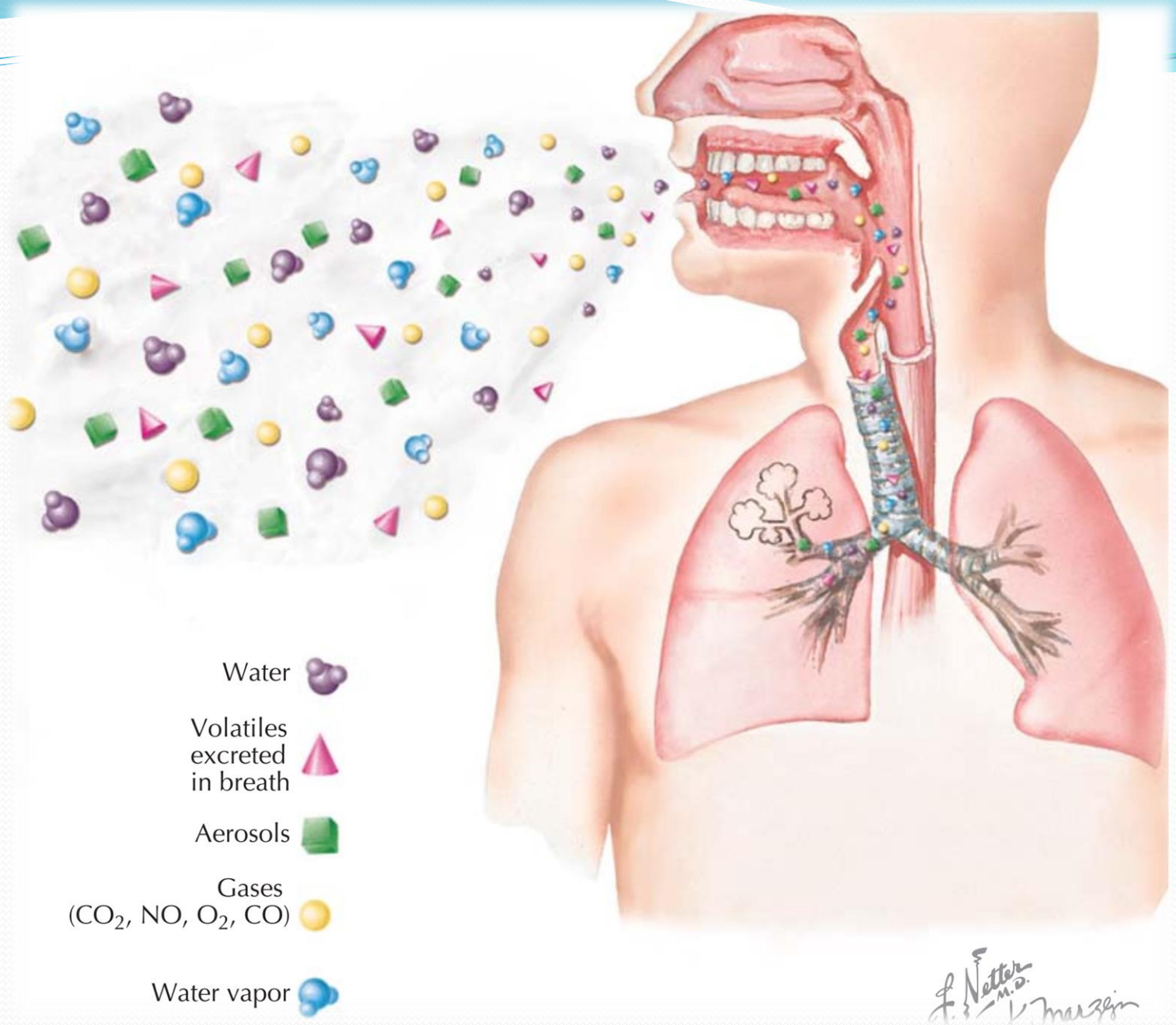
2-Inhalation as contaminated droplets

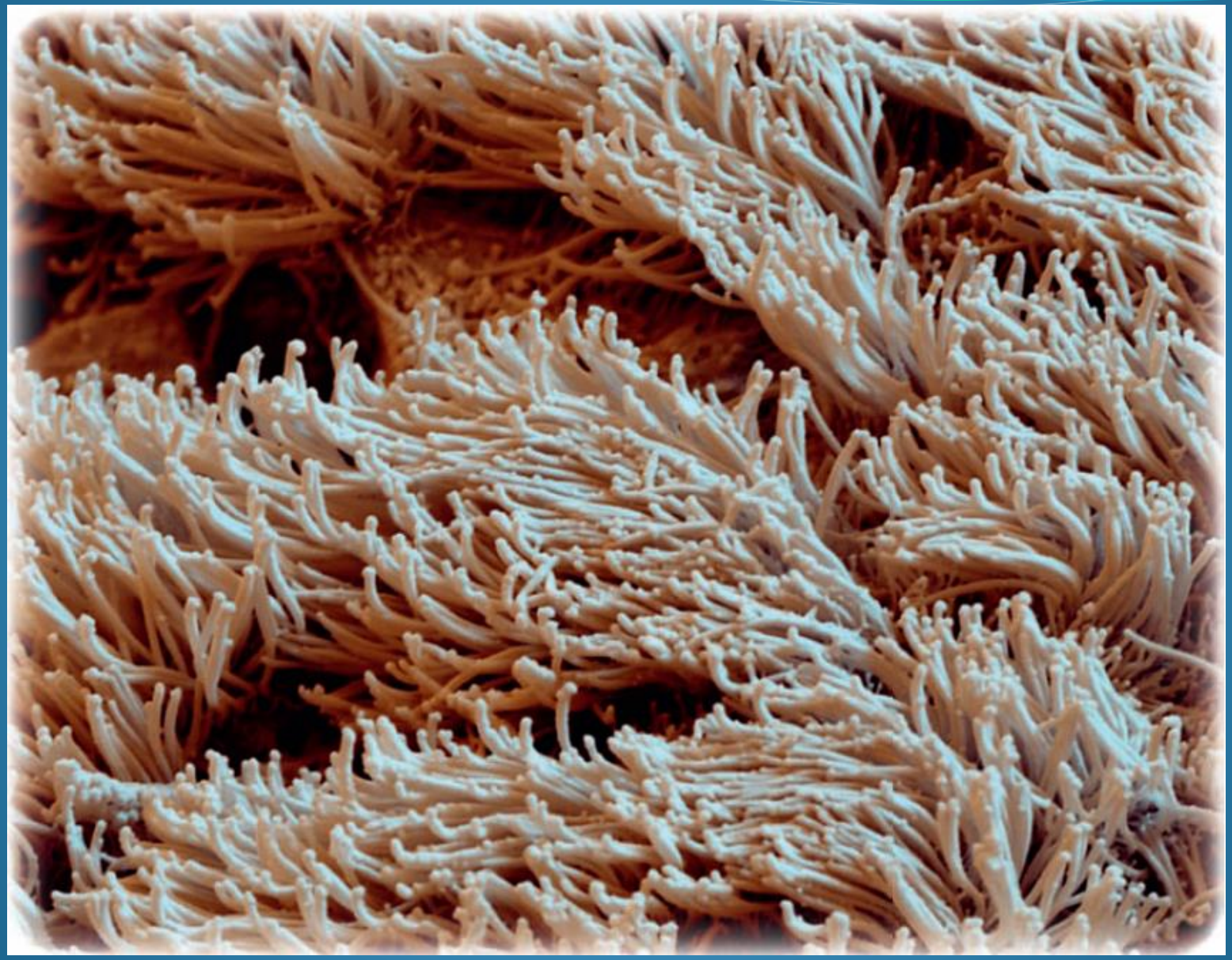
3-Hematogen (e.g., from tricuspid endocarditis)

4-adjacent spread (pleura & mediastinum)

HOST DEFENCE

- Hair and turbinate of the naire
- Mucus production and cilia; mucociliary escalator
- Gag and cough reflex
- Normal bacterial flora
- Respiratory epithelial cells ➡ defensins and cathelicidins
- Complement and IgA
- Macrophge
- Local proteins (surfactant proteins A and D)
  - intrinsic opsonizing properties or antibacterial or antiviral activity
  - engulfed by the macrophage


Water
Volatiles excreted in breath
Aerosols
Gases (CO_2, NO, O_2, CO)
Water vapor
F. Netter M.D.



Inflammatory mediators

- interleukin 1
- tumor necrosis factor

} ***Fever***

- GCSF
  - stimulate the release of neutrophils
  - both peripheral leukocytosis and increased purulent secretions
- Mediators released by macrophages
  - recruited neutrophils create an alveolar capillary leak
- erythrocytes can cross the alveolar-capillary membrane ⇒ hemoptysis

capillary leak results from alveolar filling

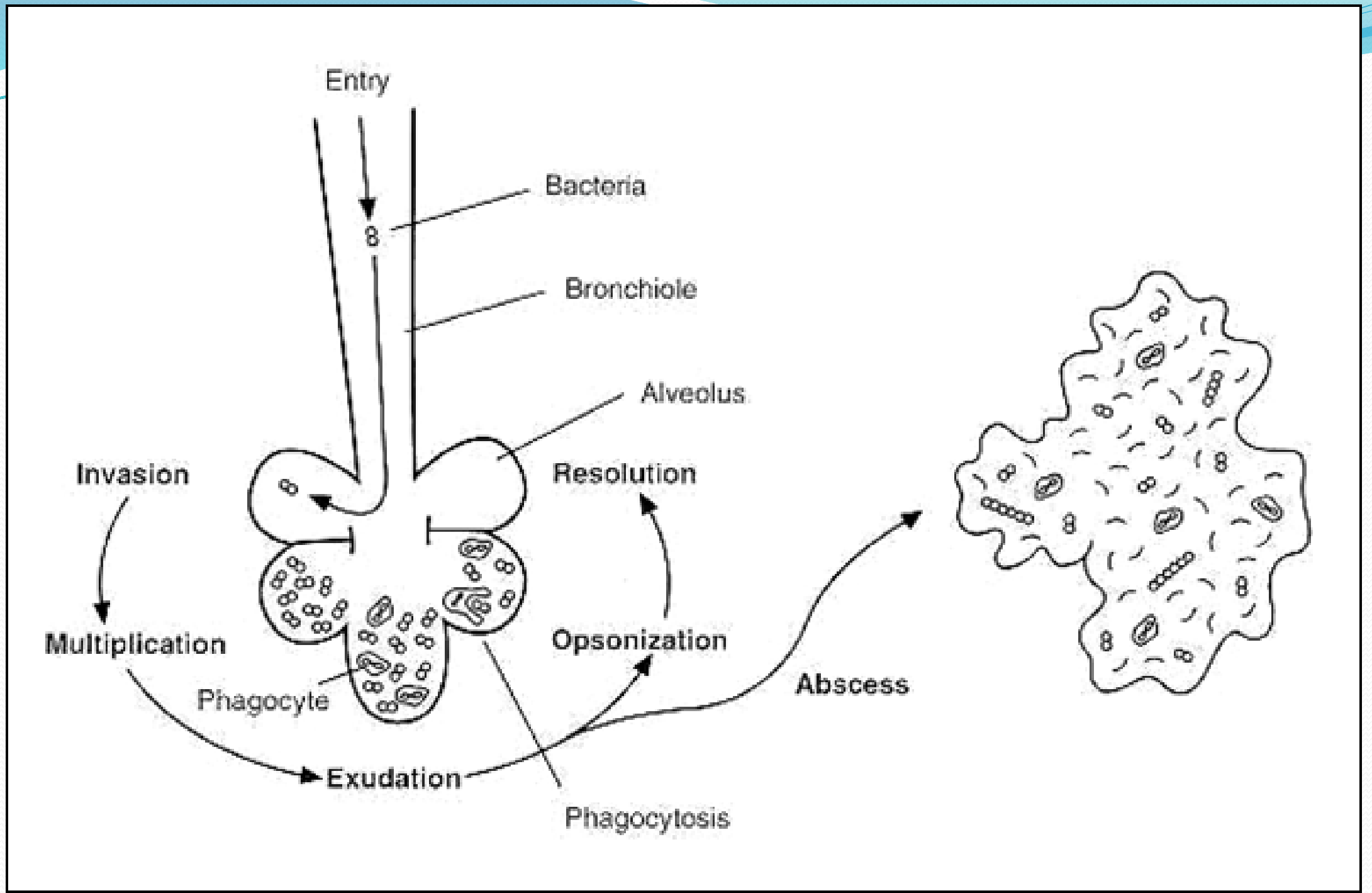
- radiographic infiltrate
- Rales on auscultation
- hypoxemia

Dyspnea

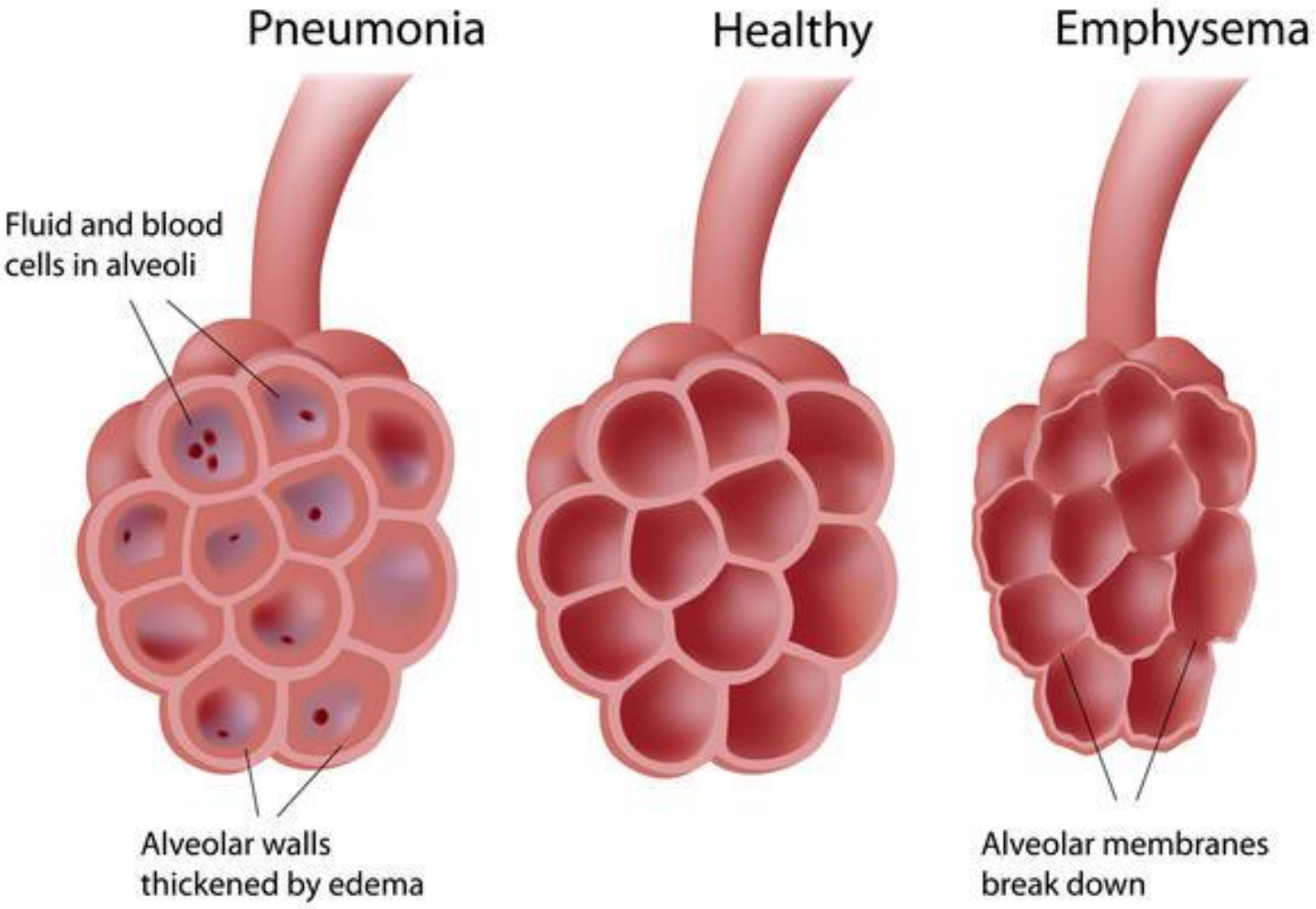
- Decreased compliance due to capillary leak
- Hypoxemia
- increased respiratory drive
- increased secretions
- occasionally infection-related bronchospasm

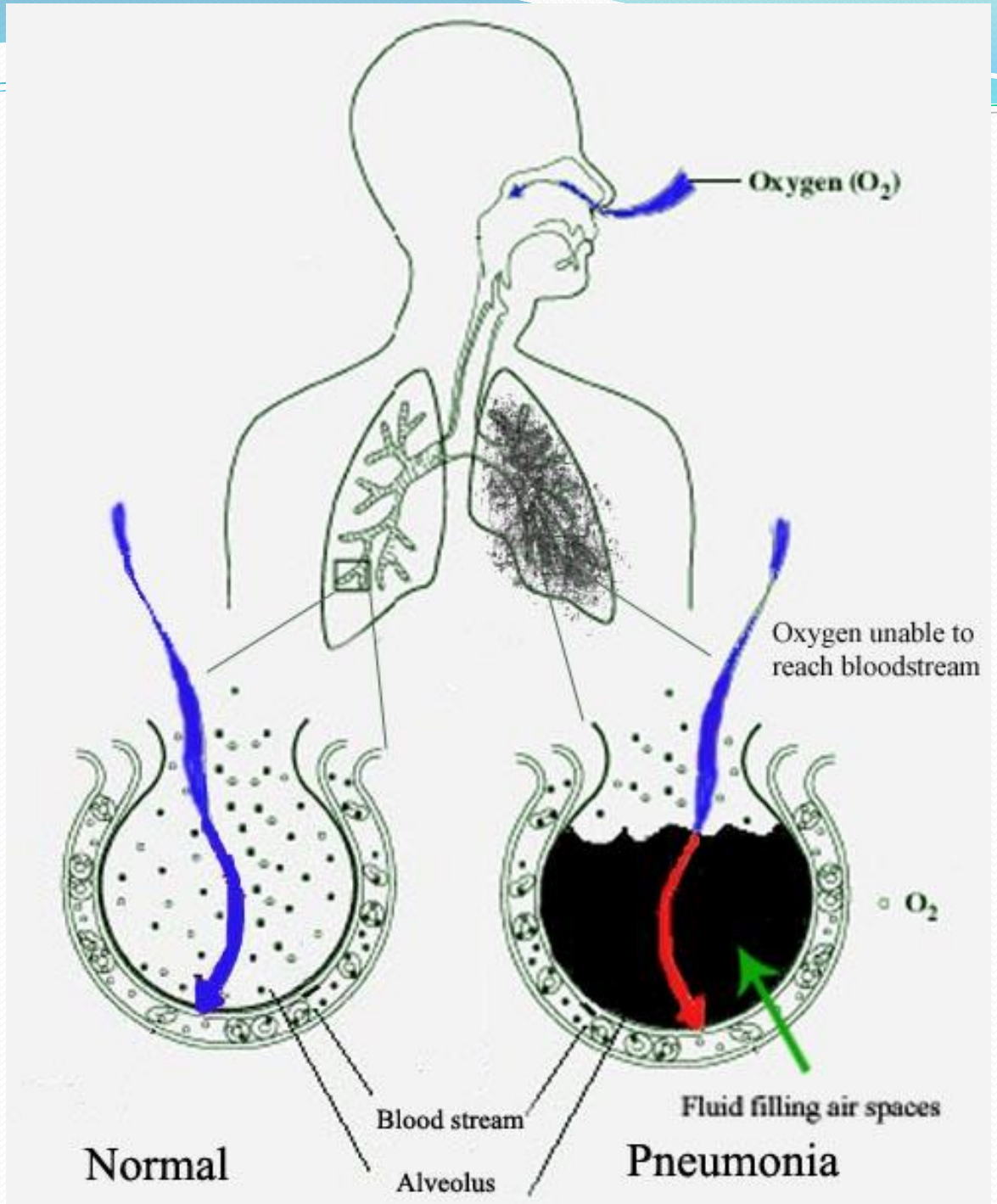
respiratory failure & death

- If severe enough
- intrapulmonary shunting of blood


Entry
Bacteria
Bronchiole
Alveolus
Invasion
Resolution
Multiplication
Opsonization
Phagocyte
Abscess
Exudation
Phagocytosis

Alveoli Changes in Lung Diseases




Oxygen (O_2)
Oxygen unable to reach bloodstream
O_2
Blood stream
Alveolus
Fluid filling air spaces
Normal
Pneumonia

Pathology

- Stage 1 : Edema
- Stage 2 : Red Hepatization (bacteria, erythrocyte,neutrophil)
- Stage 3: Gray Hepatization (neutrophil, fibrin deposits, no bacteria)
- Stage 4 :Resolution

Stage 1 : Edema

- proteinaceous exudate
- often of bacteria in the alveoli

Stage 2 : Red Hepatization

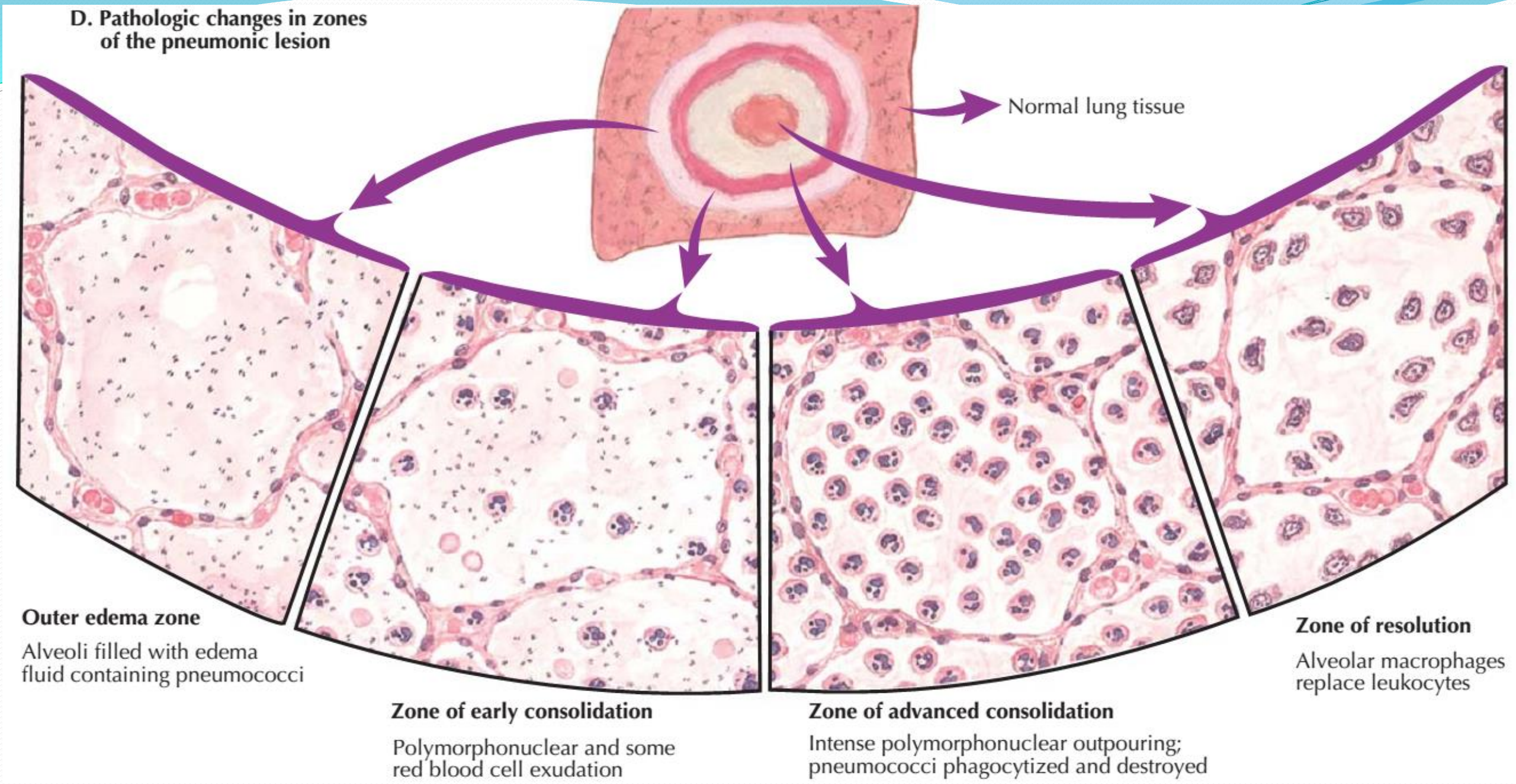
- Erythrocytes in the cellular intraalveolar exudate
- Neutrophil influx is more important
- Bacteria are occasionally seen

Stage 3 :Gray Hepatization

- no new erythrocytes are extravasating & lysed and degraded
- neutrophil is the predominant cell
- fibrin deposition is abundant
- Bacteria have disappeared

Stage 4: Resolution

- macrophage reappears as the dominant cell type in the alveolar space
- debris of neutrophils, bacteria, and fibrin has been cleared


D. Pathologic changes in zones of the pneumonic lesion
Normal lung tissue
Outer edema zone
Alveoli filled with edema fluid containing pneumococci
Zone of early consolidation
Polymorphonuclear and some red blood cell exudation
Zone of advanced consolidation
Intense polymorphonuclear outpouring; pneumococci phagocytized and destroyed
Zone of resolution
Alveolar macrophages replace leukocytes

PATHOLOGY

- lobar pneumococcal pneumonia
  - viral or Pneumocystis pneumonia
- viral and Pneumocystis pneumonias
  - Alveolar rather than interstitial processes
- In VAP, respiratory bronchiolitis
  - microaspiration mechanism
- bronchopneumonia
  - most common in nosocomial pneumonias
- Lobar pattern
  - more common in bacterial CAP

CAP ETIOLOGY

- Bacteria
- Fungi
- Viruses
- Protozoa
- Newly identified pathogens
  - Metapneumoviruses
  - coronaviruses responsible for SARS
  - Middle East respiratory syndrome
  - community-acquired strains of MRSA

TABLE 121-2 Microbial Causes of Community-Acquired Pneumonia, by Site of Care

	HOSPITALIZED PATIENTS	
OUTPATIENTS	NON-ICU	ICU
Streptococcus pneumoniae	*S. pneumoniae*	*S. pneumoniae*
Mycoplasma pneumoniae	*M. pneumoniae*	*Staphylococcus aureus*
Haemophilus influenzae	*Chlamydia pneumoniae*	*Legionella* spp.
C. pneumoniae	*H. influenzae*	Gram-negative bacilli
Respiratory viruses[a]	*Legionella* spp.	*H. influenzae*
	Respiratory viruses[a]	Respiratory viruses

CAP “typical” or “atypical” organisms

- Streptococcus pneumoniae
- Haemophilus influenza
- S. aureus
- Klebsiella pneumoniae and Pseudomonas aeruginosa

“typical”

- Mycoplasma pneumonia
- Chlamydia pneumonia
- Legionella species
- Respiratory viruses
  - influenza viruses, adenoviruses, human metapneumovirus, RSV

“atypical”

- ~10–15% of CAP cases that are polymicrobial
- “atypical” ➡ macrolide, a fluoroquinolone, or a tetracycline

Anaerobes

- episode of aspiration
  - days to weeks before presentation of pneumonia
- combination of an unprotected airway
  - alcohol or drug overdose or a seizure disorder
- significant gingivitis
- Anaerobic pneumonias are often complicated
  - abscess formation
  - significant empyemas
  - parapneumonic effusions

S. aureus pneumonia

- **HCAP**
- **CA-MRSA**
  - complicate influenza infection
- MRSA
  - primary etiologic agent of CAP
  - Uncommon
  - serious consequences, such as necrotizing pneumonia

TABLE 121-3 Epidemiologic Factors Suggesting Possible Causes of Community-Acquired Pneumonia

FACTOR	POSSIBLE PATHOGEN(S)
Alcoholism	*Streptococcus pneumoniae*, oral anaerobes, *Klebsiella pneumoniae*, *Acinetobacter* spp., *Mycobacterium tuberculosis*
COPD and/or smoking	*Haemophilus influenzae*, *Pseudomonas aeruginosa*, *Legionella* spp., *S. pneumoniae*, *Moraxella catarrhalis*, *Chlamydia pneumoniae*
Structural lung disease (e.g., bronchiectasis)	*P. aeruginosa*, *Burkholderia cepacia*, *Staphylococcus aureus*
Dementia, stroke, decreased level of consciousness	Oral anaerobes, gram-negative enteric bacteria
Lung abscess	CA-MRSA, oral anaerobes, endemic fungi, *M. tuberculosis*, atypical mycobacteria
Travel to Ohio or St. Lawrence river valley	*Histoplasma capsulatum*
Travel to southwestern United States	Hantavirus, *Coccidioides* spp.
Travel to Southeast Asia	*Burkholderia pseudomallei*, avian influenza virus
Stay in hotel or on cruise ship in previous 2 weeks	*Legionella* spp.
Local influenza activity	Influenza virus, *S. pneumoniae*, *S. aureus*
Exposure to bats or birds	*H. capsulatum*
Exposure to birds	*Chlamydia psittaci*
Exposure to rabbits	*Francisella tularensis*
Exposure to sheep, goats, parturient cats	*Coxiella burnetii*

پاتوژن های شایع	بیماری های زمینه ای و شرایط اپیدمیولوژیک
استرپ پنومونیه، بی هوازی ها، باسیل های گرم منفی	آلکلیسم
استرپ پنومونیه، هموفیلوس آنفولانزا، موراکسلا کاتارالیس، گونه های لژیونلا	استعمال دخانیات، COPD
استرپ پنومونیه، باسیل های گرم منفی، هموفیلوس آنفولانزا، استاف اورئوس، بی‌هوازی ها، کلامیدیا پنومونیه	اقامت در آسایشگاه یا خانه سالمندان
بی هوازی ها	بهداشت دهانی نامطلوب
گونه های لژیونلا	بیماری اپیدمیک لژیونرها[1]
هیستو پلاسما کپسولاتوم	مواجهه با خفاش ها یا خاک آغشته به فضولات پرندگان
کلامیدیا پسیتاسی	مواجهه با پرندگان
فرانسیسلا تولارنسیس	مواجهه با خرگوش
استرپ پنومونیه، هموفیلوس آنفولانزا، مایکوباکتریوم توبرکولوزیس	عفونت با HIV
کوکسیلا بورنتی	مواجهه با حیوانات مزرعه یا گربه های حامله
آنفولانزا، استرپ پنومونیه، استاف اورئوس، استرپ پیوژن هموفیلوس آنفولانزا	آنفولانزا فعال در جامعه
بی هوازی ها، پنومونیت شیمیایی	مشکوک به آسپیراسیون حجیم
سودوموناآئروژینوزا، برخلدریا سپاسیا، استاف اورئوس	اختلال ساختاری ریه (برونکشتازی یا سیستیک فیبروزیس)
استاف اورئوس، بی هوازی ها، مایکو باکتریوم توبرکلوزیس	سوء مصرف مواد تزریقی
بی هوازی ها	انسداد راه های هوایی

Epidemiologic factors Suggesting Possible Causes of CAP

- **COPD and/or smoking**
  - Pseudomonas aeruginosa
  - S. pneumonia

Epidemiologic factors Suggesting Possible Causes of CAP

- **Structural lung disease (e.g.,bronchiectasis)**
  - P. aeruginosa
  - Burkholderia cepacia
  - Staphylococcus aureus

Epidemiologic factors Suggesting Possible Causes of CAP

- **Dementia, stroke, decreased level of consciousness**
- Oral anaerobes
- gram-negative enteric bacteria

Epidemiologic factors Suggesting Possible Causes of CAP

- **Lung abscess**
  - CA-MRSA
  - Oral anaerobes
  - Endemic fungi
  - M. tuberculosis
  - Atypical mycobacteria

Risk factors for CAP

- Alcoholism
- Asthma
- Age of ≥70 years
  - decreased cough
  - gag reflexes
  - reduced antibody and Toll-like receptor responses
- Immunosuppression
- Institutionalization

Risk Factors of Hospital Acquired Preunionia

Patient-specific risk factors

Advanced age

Chronic underlying disease

Immunosuppression

Obesity

Malnutrition

Altered level of consciousness

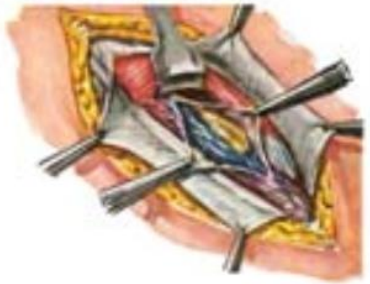
Smoking

Alcohol abuse

Drug abuse

Treatment-related risk factors

Parenteral nutrition



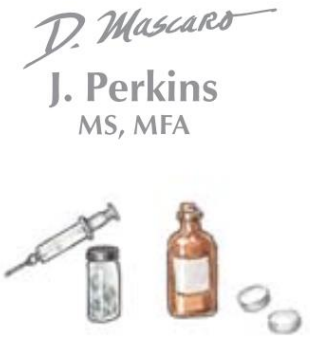
Recent surgery

Recent antibiotic exposure

Risk factors for infection with an antibiotic-resistant organism

Prolonged hospitalization

Chronic illness



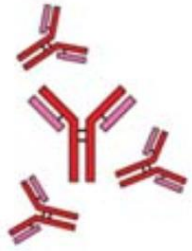
Prior antibiotic exposure

Home infusion therapy or home wound care

Nursing home resident

Recent hospitalization

Hemodialysis



Immunosuppression

Enterobacteriaceae

- recently been hospitalized
- received antibiotic therapy
- comorbidities such as alcoholism, heart failure, or renal failure

- Salmonella
- Escherichia coli
- Yersinia pestis
- Klebsiella
- Shigella
- Proteus
- Enterobacter
- Serratia
- Citrobacter

P. aeruginosa

- Severe structural lung disease
  - Bronchiectasis
  - cystic fibrosis
  - Severe COPD

Clinical Presentation

- Fever
- altered general well-being
- ***respiratory symptoms, such as***
- cough (90%)
- sputum production (66%)
- dyspnea (66%)
- pleuritic pain (50%)
- hemoptysis (15%)

CLINICAL MANIFESTATIONS

- mild to fatal in severity
  - constitutional findings
  - limited to the lung & associated structures
- frequently febrile with tachycardia
- history of chills and/or sweats
- Cough
  - Nonproductive or productive of mucoid, purulent, or blood-tinged sputum
  - Gross hemoptysis is suggestive of CA-MRSA pneumonia

CLINICAL MANIFESTATIONS

- Depending on severity
  - able to speak in full sentences
  - very short of breath
- If the pleura is involved
  - pleuritic chest pain
- Up to 20% gastrointestinal symptoms
  - nausea, vomiting, and/or diarrhea
- Other symptoms
  - fatigue, headache, myalgias, and arthralgias

physical examination

- degree of pulmonary consolidation
- presence or absence of a significant pleural effusion
- An increased respiratory rate
- use of accessory muscles of respiration
- Palpation may reveal increased or decreased
- tactile fremitus
- percussion

dull to flat

- reflecting underlying consolidated lung and pleural fluid

physical examination (auscultation)

- Crackles
- bronchial breath sounds
- possibly a pleural friction rub

- not be so obvious in the elderly
- Severely ill patients may have septic shock and evidence of organ failure

Diagnosis of pneumonia

- ***In older patients*** especially ***multiple comorbidities***
- general weakness
- decreased appetite
- altered mental status
- Incontinence
- decompensation due to underlying disease

Diagnosis of pneumonia

- The presence of **tachypnea**
- precede other signs of pneumonia by 1 to 2 days
- Tachycardia
- Fever is ***absent*** in 30% to 40% of older patients
- diagnosis of CAP is frequently delayed in older adults
- altered mental status without fever

Relative Bradycardia with pneumonia due to

- Legionella
- C. psittaci
- Mycoplasma
- F. tularensis

DIAGNOSIS

- Is this pneumonia?
- clinical and radiographic methods

- likely etiology?
- aid of laboratory techniques

Clinical Diagnosis

- **differential diagnosis**
- ***Infectious***
  - acute bronchitis
  - acute exacerbations of chronic bronchitis
- ***Noninfectious***
  - heart failure
  - pulmonary embolism
  - Hypersensitivity pneumonitis
  - radiation pneumonitis

Clinical Diagnosis

- **careful history**

- known cardiac disease
  - may suggest worsening pulmonary edema

- underlying carcinoma
  - may suggest lung injury secondary to irradiation

Clinical Diagnosis

- **physical examination**
- sensitivity 58%
- specificity 67%

- chest radiography is often necessary to differentiate CAP

Radiographic findings

- risk factors for increased severity
  - cavitation
  - multilobar involvement
- Occasionally, radiographic results suggest an etiologic diagnosis
- pneumatoceles
  - suggest infection with S. aureus
- upper-lobe cavitating lesion
  - suggests tuberculosis
- CT may be of value in a patient with suspected postobstructive

Radiographic findings CTscan

- suspected postobstructive pneumonia
  - tumor
  - foreign body
- suspected cavitary disease

For outpatients

- **clinical and radiologic assessments**
- laboratory results are not available soon enough

- rapid diagnosis of influenza virus infection
  - specific anti-influenza drug treatment and secondary prevention

Etiologic Diagnosis

- clinical presentation?
  - Except for CAP
- patients admitted to the ICU
  - Treatment directed at a specific pathogen
    - superior to empirical therapy?
- Identification of an unexpected pathogen
  - narrowing of the initial empirical regimen
    - decreasing antibiotic selection
    - lessening the risk of resistance

Etiologic Diagnosis

- Pathogens with important public safety implications
  - Mycobacterium tuberculosis
  - Influenza virus

- without culture and susceptibility data
  - Resistance?
  - Appropriate empirical therapeutic?

Gram’s stain and Culture of sputum

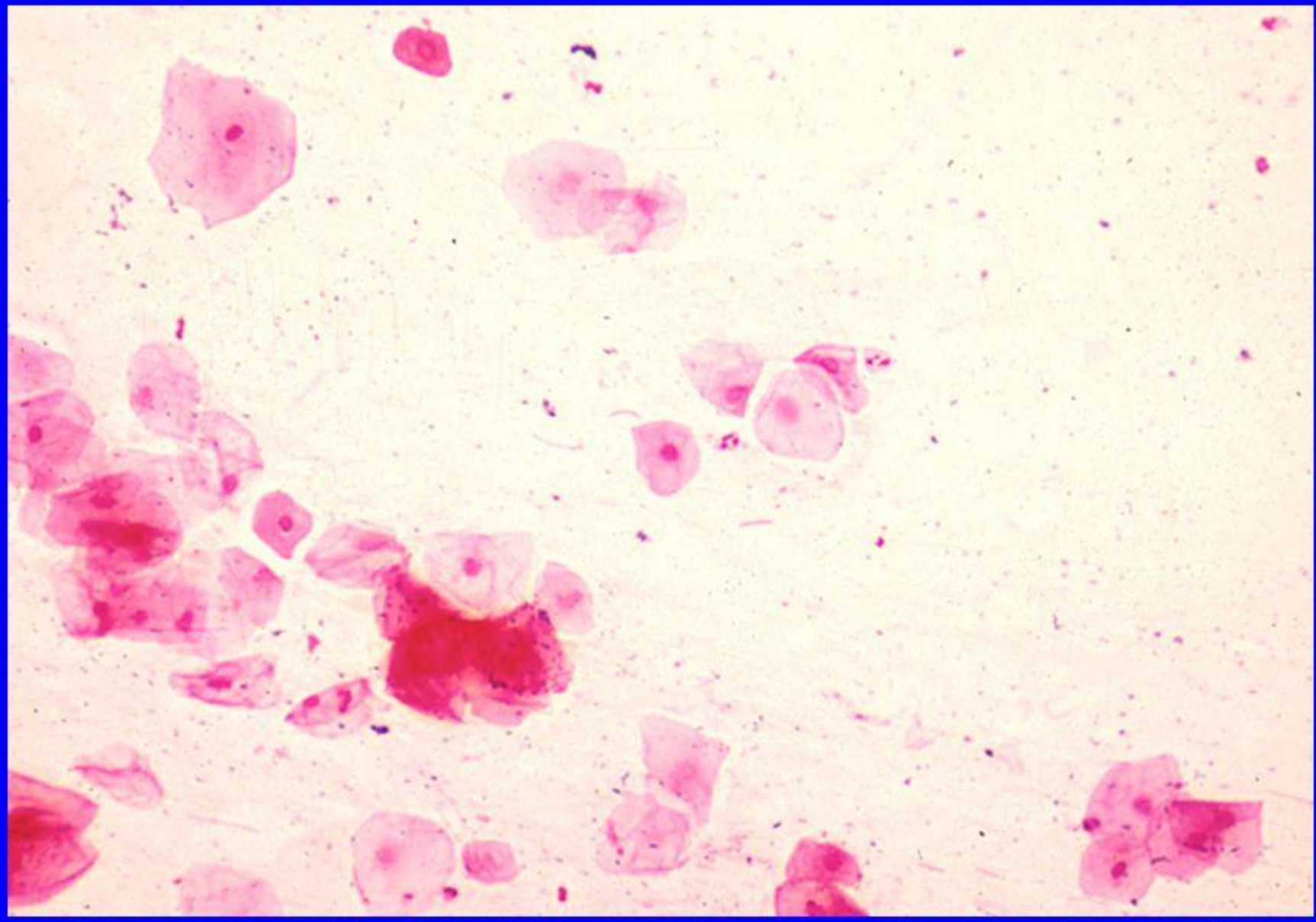
- Gram’s staining
  - S. pneumonia
  - S. aureus
  - gram-negative bacteria

Gram's stain and Culture of sputum

- sputum sample per low-power field
  - >25 neutrophils
  - <10 squamous epithelial cells
-
- **Even in cases of proven bacteremic pneumococcal pneumonia**
  - **Yield of positive cultures from sputum samples is ≤50%**

D OSIS
Sp

- x ation)



Squamous epithelial cells are easily seen and recognized under low power magnification.

No s

Man ower field

Gram's stain and Culture of sputum

- ICU and intubated
  - deep-suction aspirate or bronchoalveolar lavage
    - high yield on culture
- etiologies in severe CAP
  - staining and culturing respiratory secretions
    - unsuspected and/or resistant pathogens
- specific stains for M. tuberculosis or fungi

Blood Cultures?

- ***low yield and the lack of significant impact on outcome***
  - disappointingly low Only 5–14% hospitalized with CAP are positive
  - most frequently isolated pathogen is S. pneumonia
- ***Certain high-risk patients***
  - ***Neutropenia secondary to pneumonia***
  - ***Asplenia***
  - ***Complement deficiencies***
  - ***Chronic liver disease***
  - ***Severe CAP***

urinary antigen tests

- pneumococcal antigen in urine
  - sensitive and specific (80% and >90%)

- Legionella antigen in urine
  - sensitive and specific (90% and 99%)
    - only serogroup 1

- ***detect antigen even after the initiation of appropriate antibiotic therapy***

Polymerase chain reaction (PCR) tests

- ***amplify a microorganism's DNA or RNA***
- PCR of nasopharyngeal swabs
  - Respiratory viral infection
  - Legionella species
  - M. pneumonia
  - C. pneumonia
  - Mycobacteria

Serology

- A fourfold rise in specific IgM antibody titer
  - Between acute- and convalescent-phase serum samples
- In the past
  - Atypical pathogens
  - Unusual organisms such as Coxiella burnetii
- Recently, fallen out of favor

Biomarkers

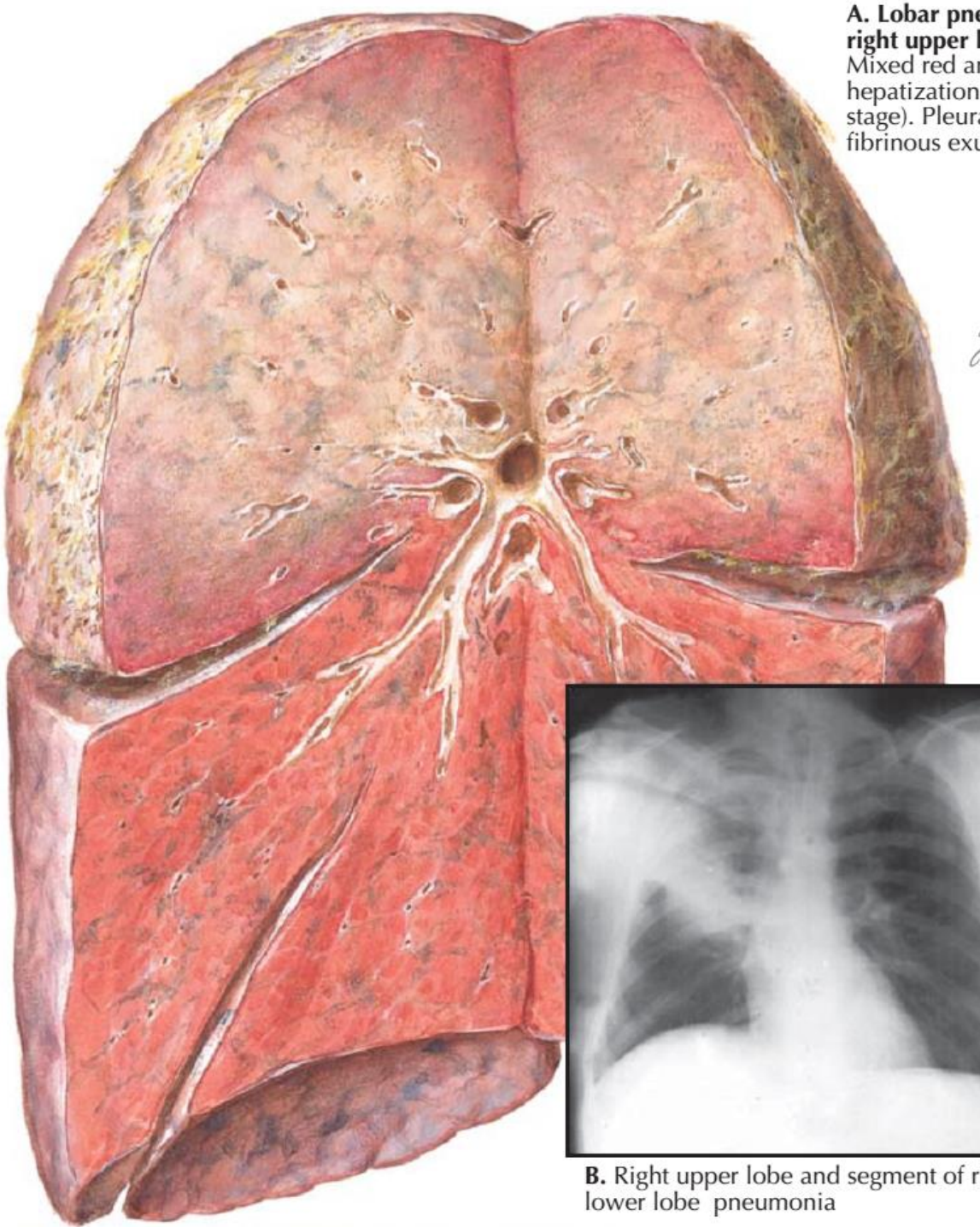
- **C-reactive protein (CRP)**
- **Procalcitonin (PCT)**

- particularly to bacterial pathogens

Biomarkers

- C-reactive protein (CRP)
  - worsening disease or treatment failure
- Procalcitonin (PCT)
  - need for antibacterial therapy

physical examination, radiology, and laboratory tests



A. Lobar pneumonia; right upper lobe. Mixed red and gray hepatization (transition stage). Pleural fibrinous exudate

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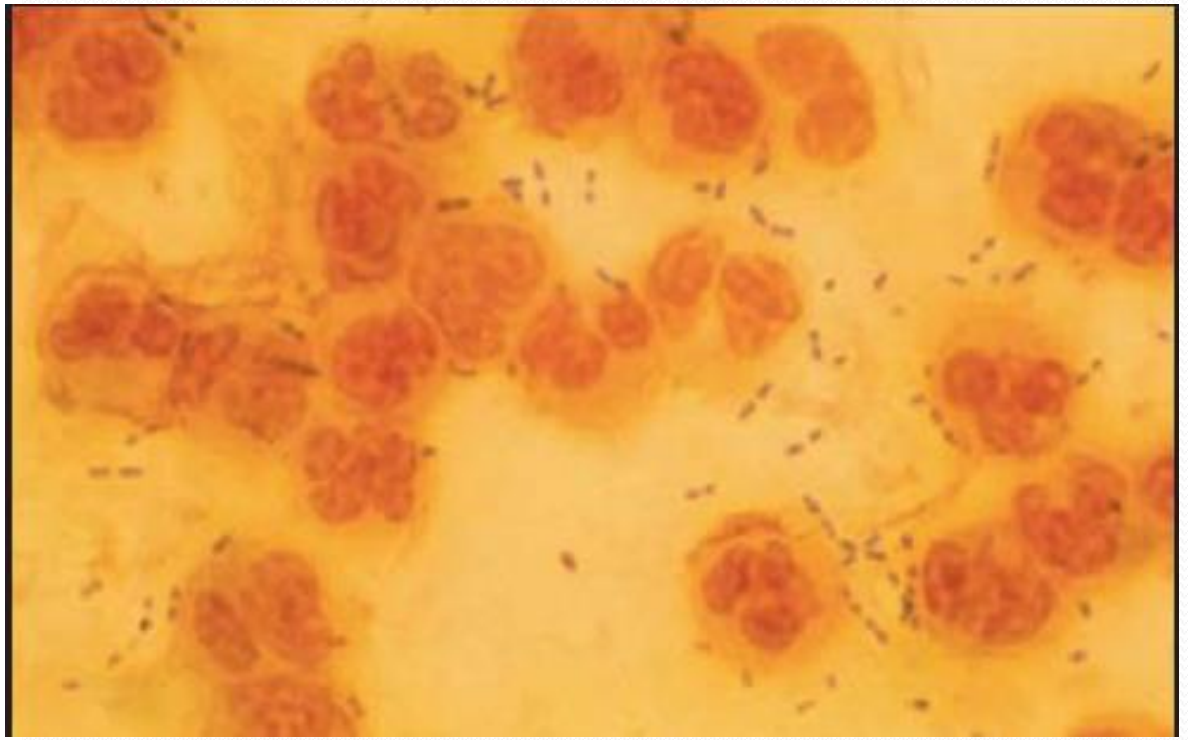
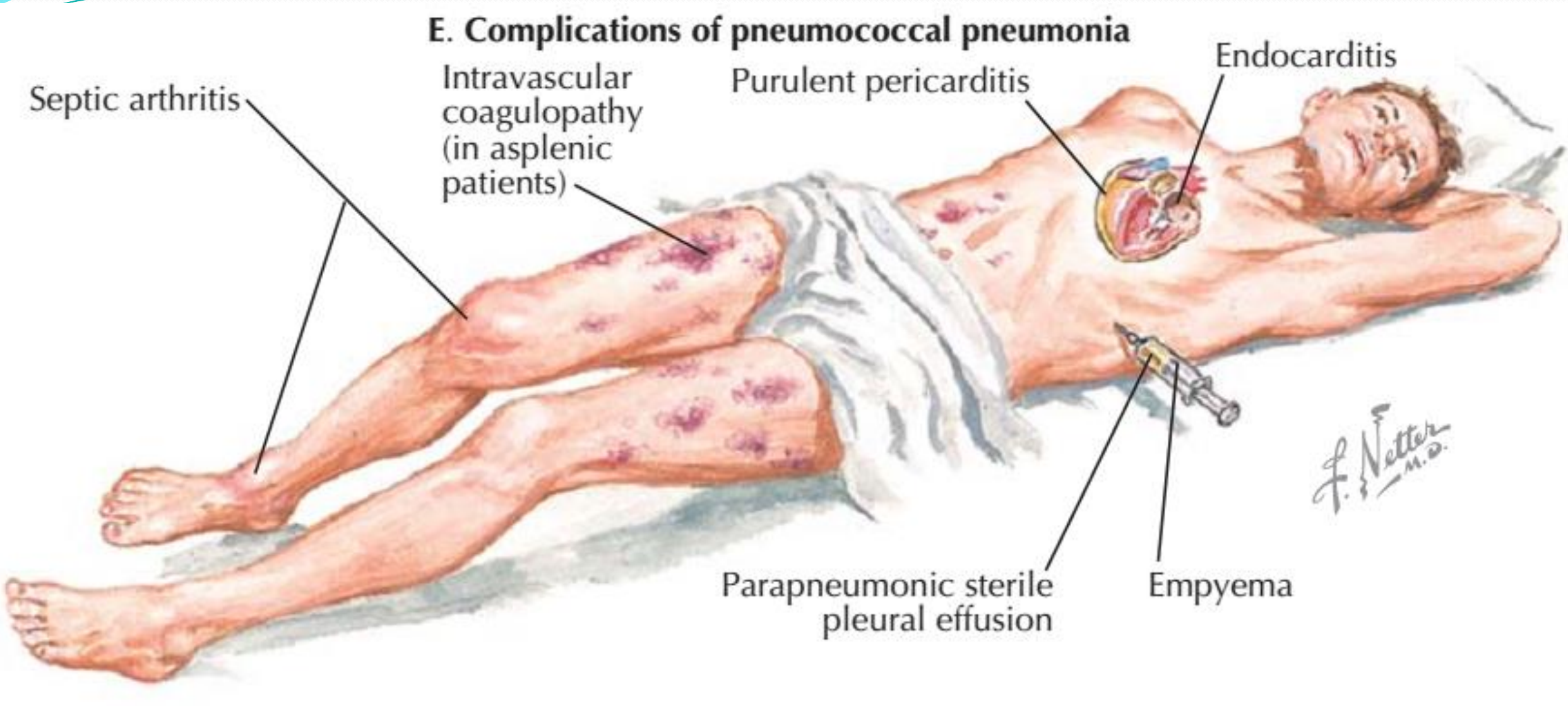
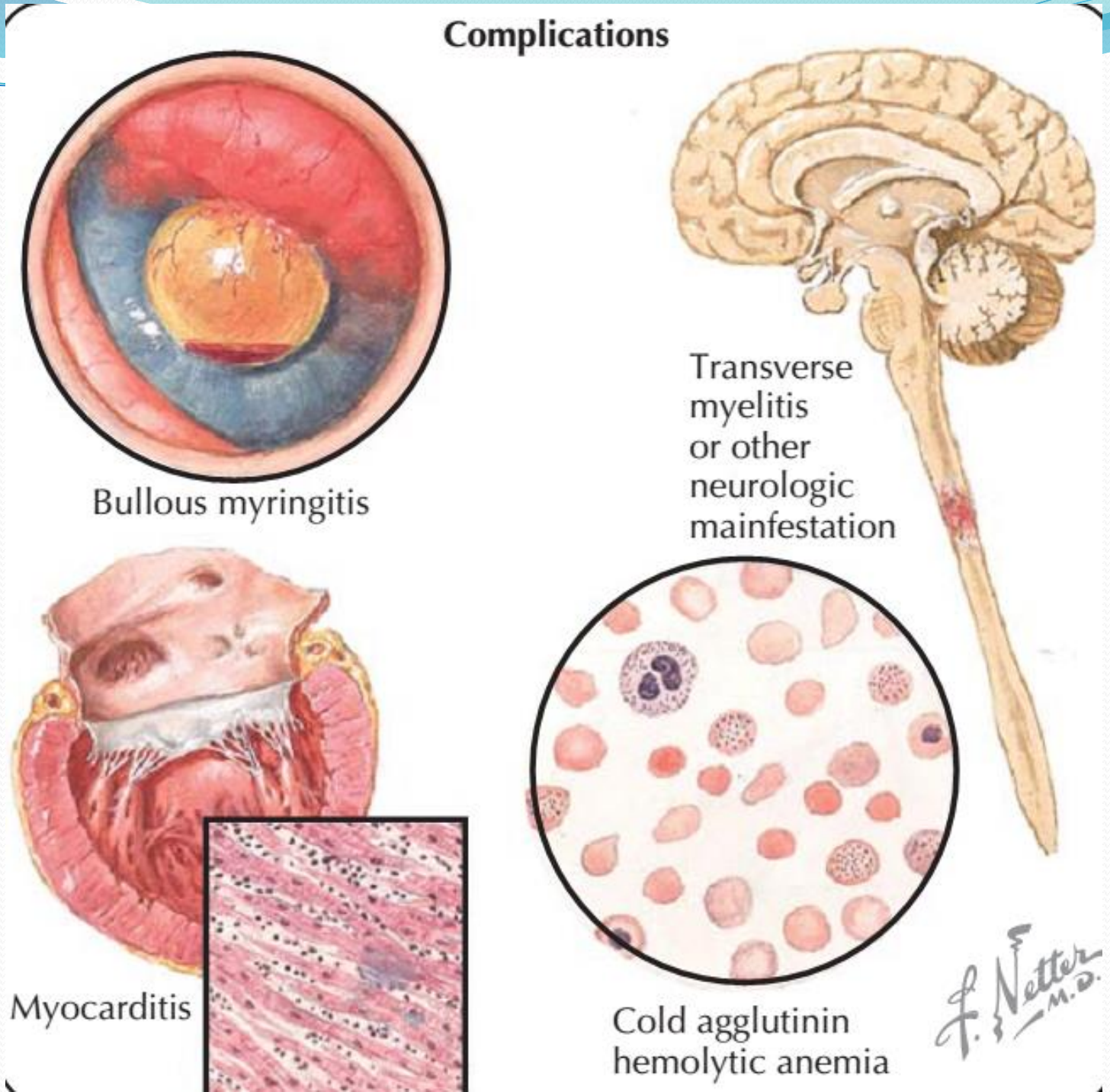
B. Right upper lobe and segment of right lower lobe pneumonia




E. Complications of pneumococcal pneumonia
Septic arthritis
Intravascular coagulopathy (in asplenic patients)
Purulent pericarditis
Endocarditis
Parapneumonic sterile pleural effusion
Empyema
F. Netter M.D.

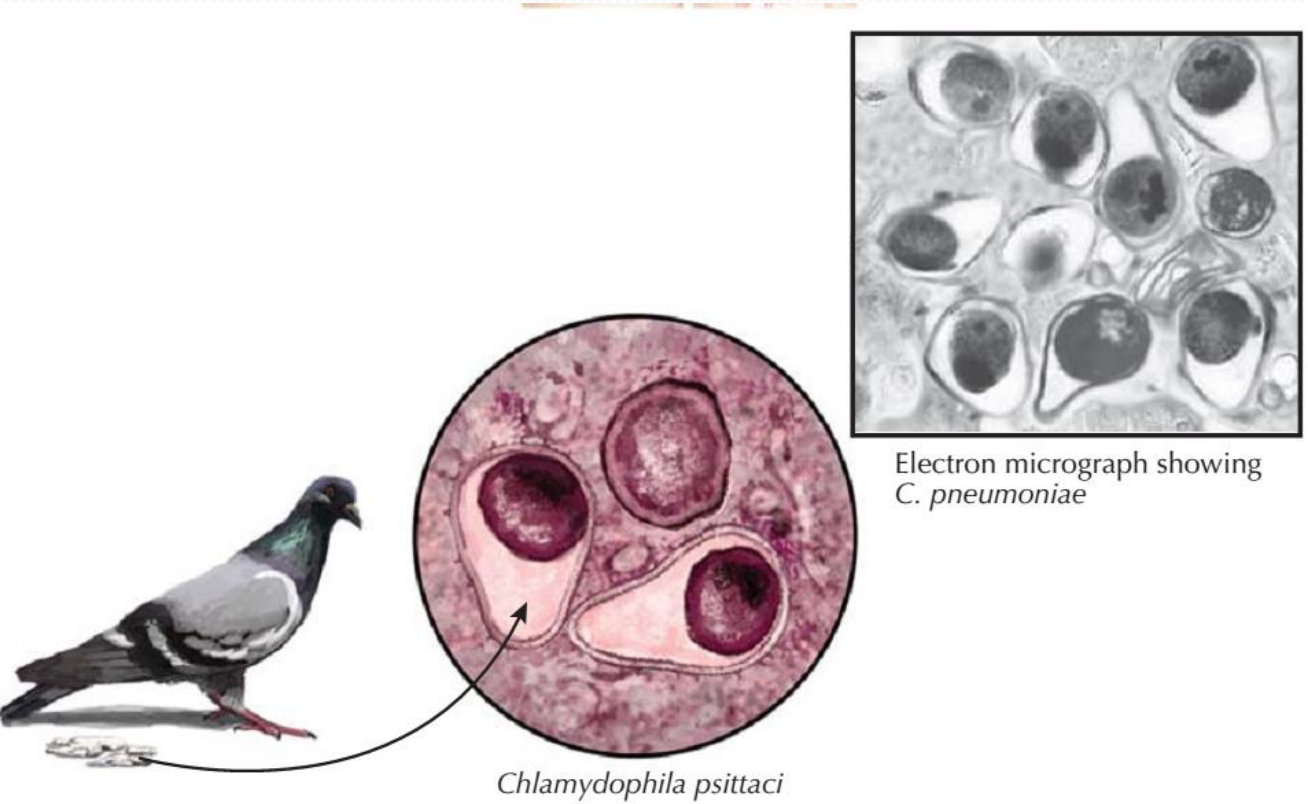
M. pneumoniae



Extrapulmonary manifestations M. pneumoniae

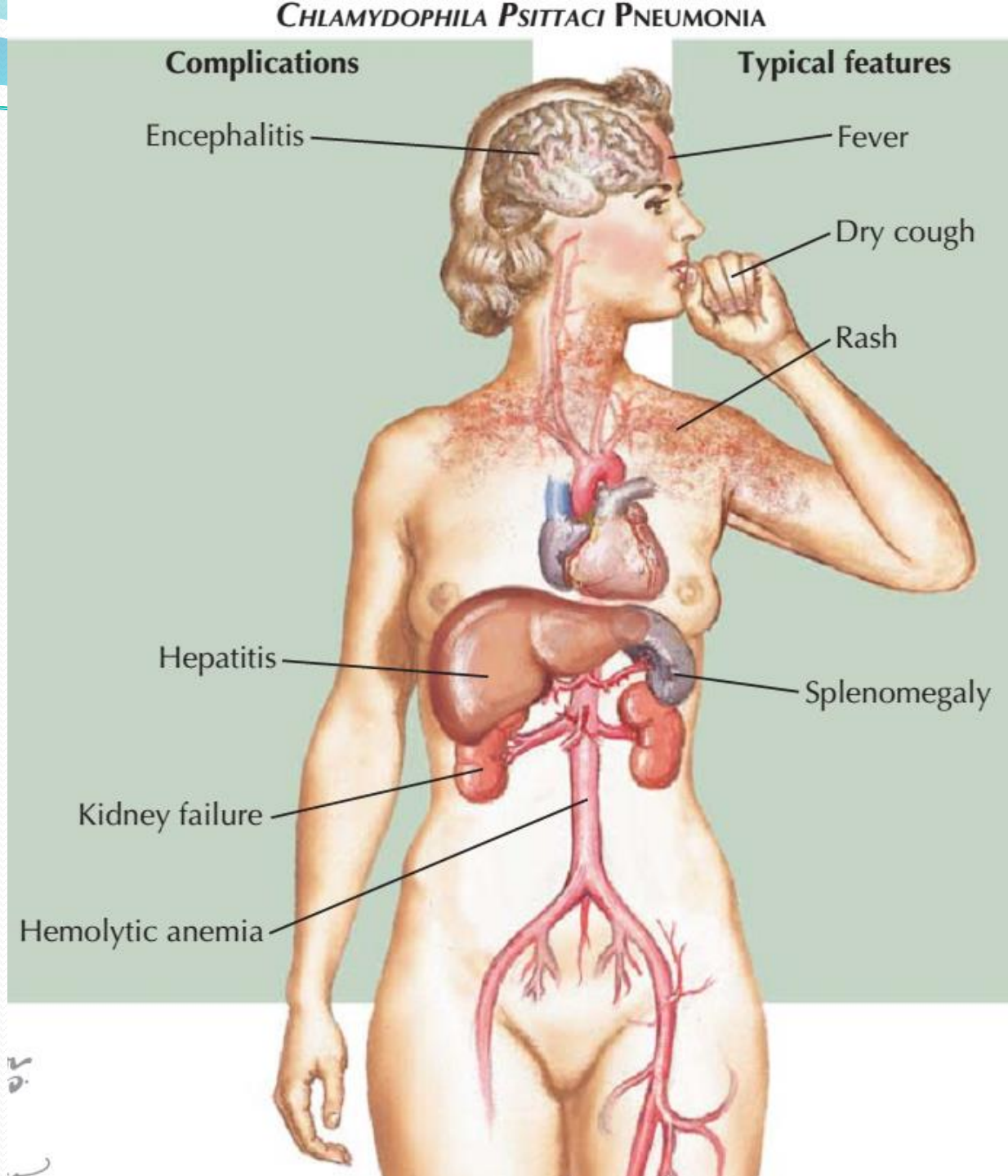
- Arthralgia
- Cervical lymphadenopathy
- Bullous myringitis
- Diarrhea
- Myalgia
- Myocarditis
- Hepatitis
- Nausea
- Pericarditis
- Vomiting

CHLAMYDOPHILA PSITTACI PNEUMONIA



Electron micrograph showing *C. pneumoniae*

Chlamydophila psittaci



Pneumonia Severity Index (PSI)

- 20 variables
- Age
- coexisting illness
- Abnormal physical findings
- Abnormal Laboratory findings

اندکس شدت پنومونی (PSI)	امتیاز
● شاخص های دموگرافیک	
▪ سن (مذکر)	سن (سال)
▪ سن (مؤنث)	سن (سال) -۱۰
▪ سکونت در آسایشگاه یا خانه سالمندان	+۱۰
● بیماری های همراه	
▪ بیماری های نئوپلاستیک	+۳۰
▪ بیماری کبدی	+۲۰
▪ نارسایی قلبی	+۱۰
▪ بیماری عروقی مغزی	+۱۰
▪ بیماری کلیوی	+۱۰
● یافته های معاینه بالینی	
▪ اختلال سطح هوشیاری	+۲۰
▪ تعداد تنفس ≤ ۳۰ در دقیقه	+۲۰
▪ فشار سیستولیک < ۹۰ mmHg	+۱۵
▪ درجه حرارت بدن < ۳۵° C یا ≥۴۰°C	+۱۵
▪ تعداد ضربان قلب ≤ ۱۲۵ در دقیقه	+۱۰
● یافته های آزمایشگاهی	
▪ PH شریانی < ۷/۳۵	+۳۰
▪ BUN ≤ ۳۰ $^{mg}/_{dl}$	+۲۰
▪ گلوکز < ۲۵۰ $^{mg}/_{dl}$	+۱۰
▪ هموگلوبین < ۹ $^{g}/_{dl}$ یا هماتوکریت < ٪۳۰	+۱۰
▪ Po2 < ۶۰ mmHg یا O2 Sat < ٪۹۰	+۱۰
▪ پلورال افیوژن	+۱۰

CURB-65 score

- **C**onfusion
- **U**rea >7 mmol/L
- **R**espiratory rate ≥30/min
- **B**lood pressure,
  - systolic ≤90 mmHg or diastolic ≤60 mmHg
- Age ≥ **65** years

CURB-65 criteria 30-day mortality rate

- score of 0, **1.5%**, treated outside the hospital
- score of 2, **9.2%**, should be admitted to the hospital
- scores of ≥3, **22%** overall; require ICU admission
- Septic shock
- respiratory failure

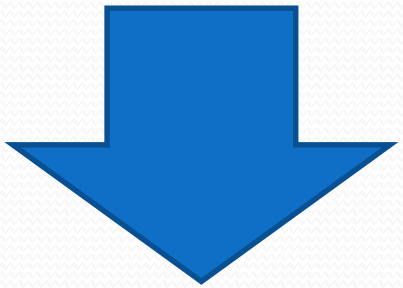
} **indication for ICU care**

TABLE 121-4 Risk Factors for Early Deterioration in Community-Acquired Pneumonia

Multilobar infiltrates	Hypoalbuminemia
Severe hypoxemia (arterial saturation <90%)	Neutropenia
Severe acidosis (pH <7.30)	Thrombocytopenia
Mental confusion	Hyponatremia
Severe tachypnea (>30 breaths/min)	Hypoglycemia

ANTIBIOTIC RESISTANCE

- For CAP



- S. pneumoniae
- CA-MRSA

INITIAL ANTIBIOTIC MANAGEMENT

- Empirical
- cover the most likely pathogens
- should be initiated as expeditiously as possible

Outpatients

1. Previously healthy and no antibiotics in past 3 months

- Macrolide (clarithromycin or azithromycin)
- ***or***
- Doxycycline

Outpatients

2. Comorbidities or antibiotics in past 3 months:

- respiratory fluoroquinolone (moxifloxacin ,gemifloxacin, levofloxacin)
- **or**
- β-lactam high-dose
  - amoxicillin [1 g tid]
  - amoxicillin/clavulanate [2 g bid]
- alternatives:
  - Ceftriaxone [1–2 g IV qd],
  - Cefpodoxime [200 mg PO bid]
  - Cefuroxime [500 mg PO bid])

plus a macrolide

Inpatients, Non-ICU

- A respiratory fluoroquinolone (moxifloxacin or levofloxacin)
- **OR**
- A β-lactam (ceftriaxone, ampicillin, cefotaxime, ertapenem)
- **plus**
- Macrolided
  - clarithromycin
  - azithromycin
    - or IV azithromycin

Inpatients, ICU

- A β-lactame
  - ceftriaxone [2 g IV qd]
  - ampicillin-sulbactam [2 g IV q8h],
  - cefotaxime [1–2 g IV q8h])
- **plus**
- Azithromycin
- or
- Fluoroquinolone

Special Concerns
If Pseudomonas is a consideration:

- An antipseudomonal β-lactam
  - piperacillin/tazobactam [4.5 g IV q6h]
  - cefepime [1–2 g IV q12h]
  - imipenem [500 mg IV q6h]
  - meropenem [1 g IV q8h])
- **Plus**
- ciprofloxacin (400 mg IV q12h) or levofloxacin (750 mg IV qd)

Special Concerns
If Pseudomonas is a consideration:

- An antipseudomonal β-lactam
  - piperacillin/tazobactam [4.5 g IV q6h]
  - cefepime [1–2 g IV q12h]
  - imipenem [500 mg IV q6h]
  - meropenem [1 g IV q8h])
- **Plus**
- aminoglycoside (amikacin [15 mg/kg qd] or tobramycin [1. 7 mg/kg qd])
- **Plus**
- azithromycin

Special Concerns
If Pseudomonas is a consideration:

- An antipseudomonal β-lactam
  - piperacillin/tazobactam [4.5 g IV q6h]
  - cefepime [1–2 g IV q12h]
  - imipenem [500 mg IV q6h]
  - meropenem [1 g IV q8h])
- **Plus**
- aminoglycoside (amikacin [15 mg/kg qd] or tobramycin [1. 7 mg/kg qd])
- **Plus**
- Antipneumococcal fluoroquinolone

Special Concerns

If CA-MRSA is a consideration:

- Add
- linezolid (600 mg IV q12h)
- **or**
- vancomycin (15 mg/kg q12h)

Special Concerns

For penicillin allergic patients:

- use a respiratory fluoroquinolone
- and
- aztreonam (2 g IV q8h)

Skin lesions

- **Erythema multiforme or Erythema nodosum**
- Mycoplasma infection (as well as tuberculosis and endemic fungal)

- **Ecthyma gangrenosum** are most often seen with P. aeruginosa

Laboratory Evaluation

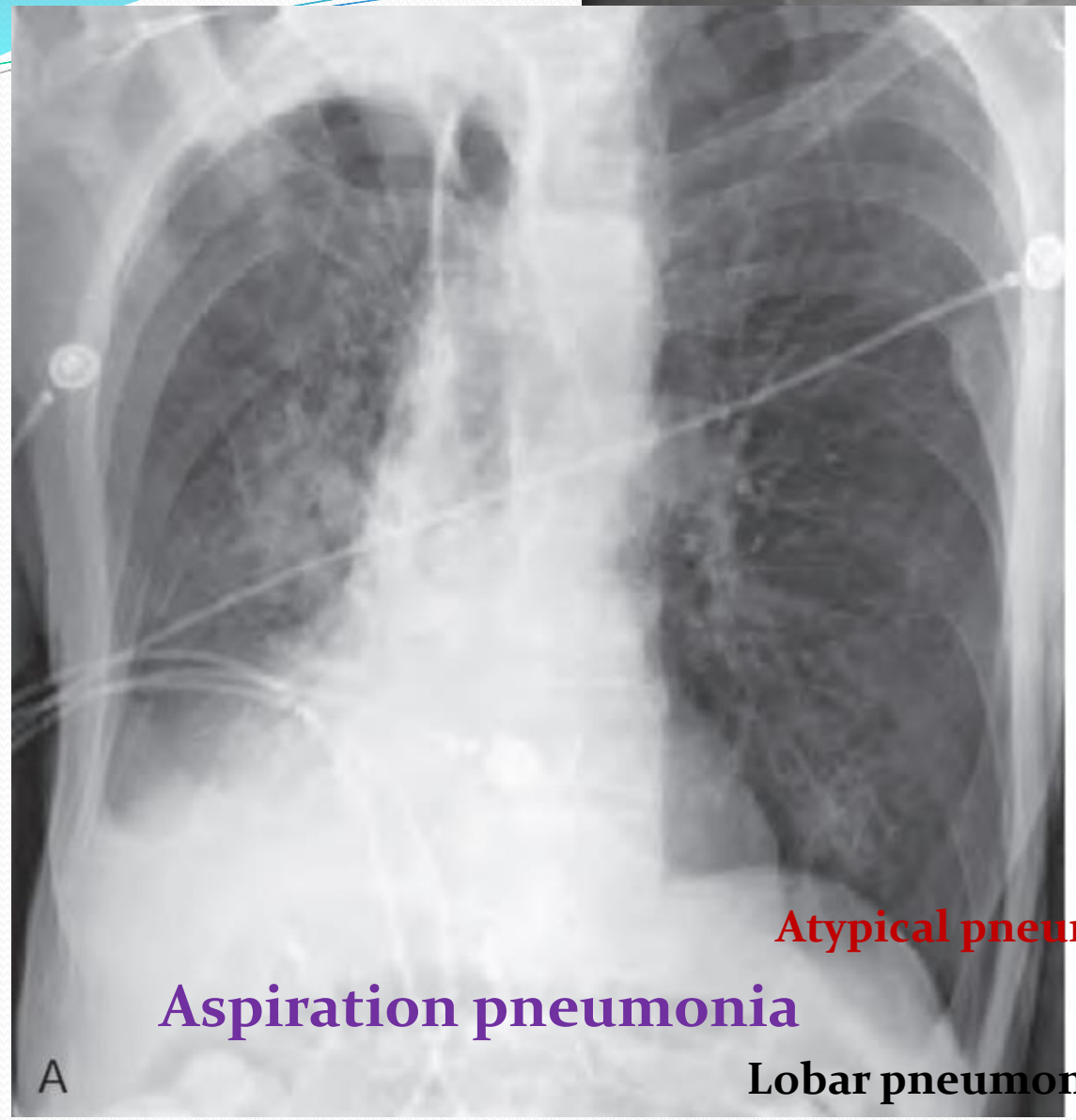
- blood cell counts
- serum glucose
- electrolyte
- pulse oximetry or arterial blood gas assays

- HIV testing, particularly in patients with no other risk factors for CAP

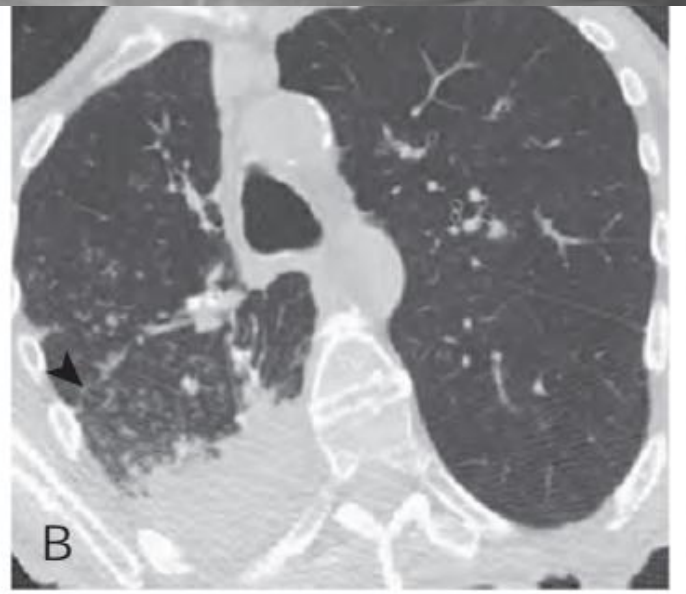
Marked leukocytosis with a leftward shift

- ***S. pneumoniae***
- ***H. influenza***
- ***gram-negative bacilli***

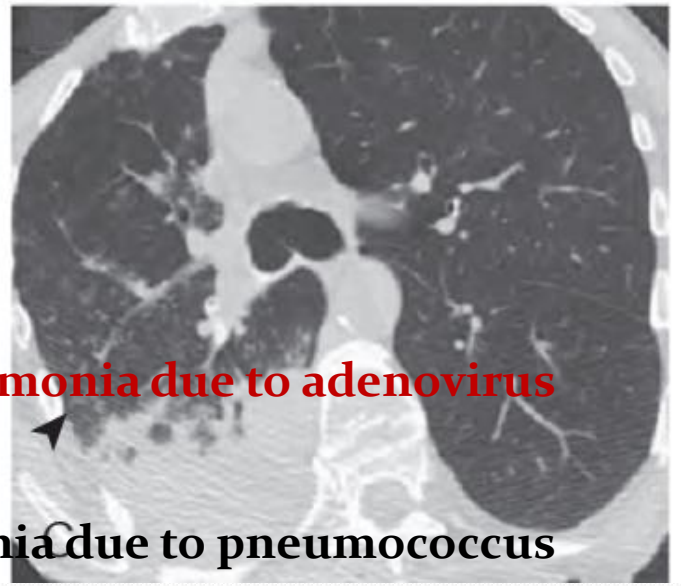
- M. pneumoniae
- Chlamydophila species
- Coxiella
- nonbacterial causes of pneumonia

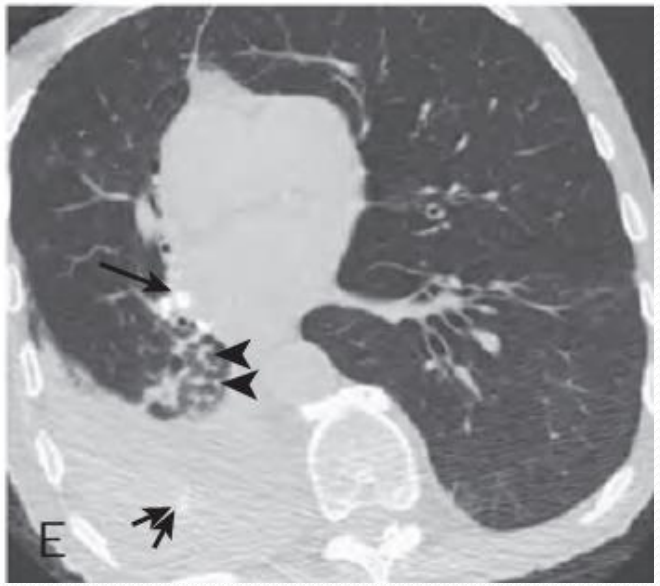


Aspiration pneumonia



Atypical pneumonia due to adenovirus





Lobar pneumonia due to pneumococcus

موارد منفی رادیوگرافی قفسه سینه

- دهیدراتاسیون
- پنومونی در زمینه نوتروپنی شدید
- بیمارانی که در ۲۴ساعت اول شروع بیماری مورد ارزیابی قرار می گیرند

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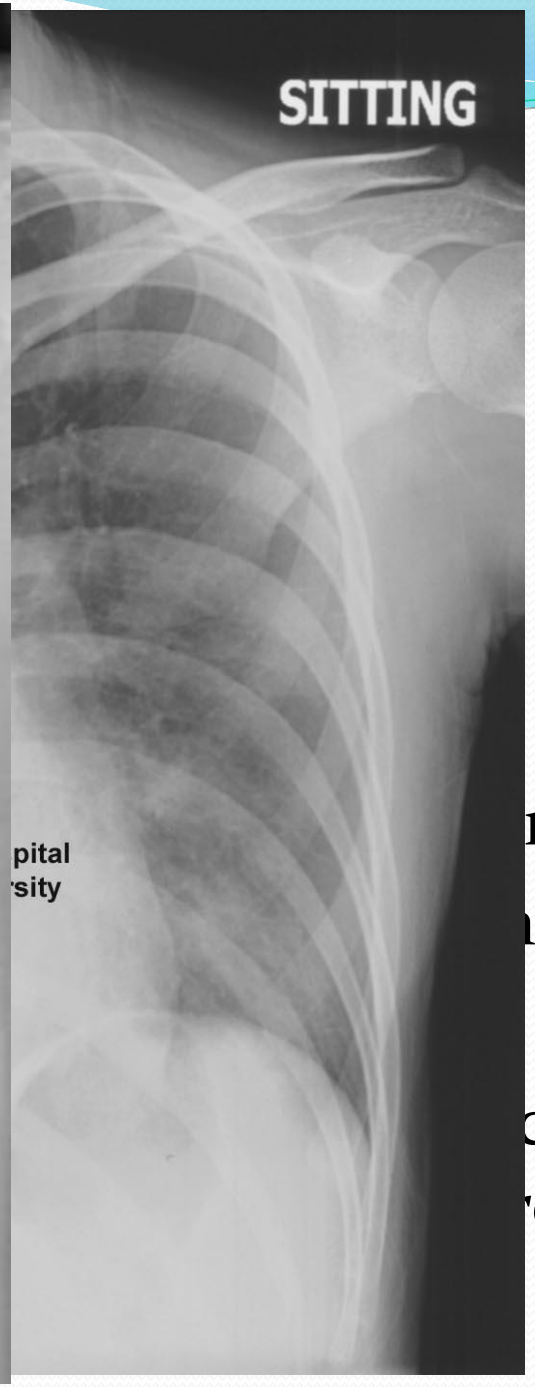

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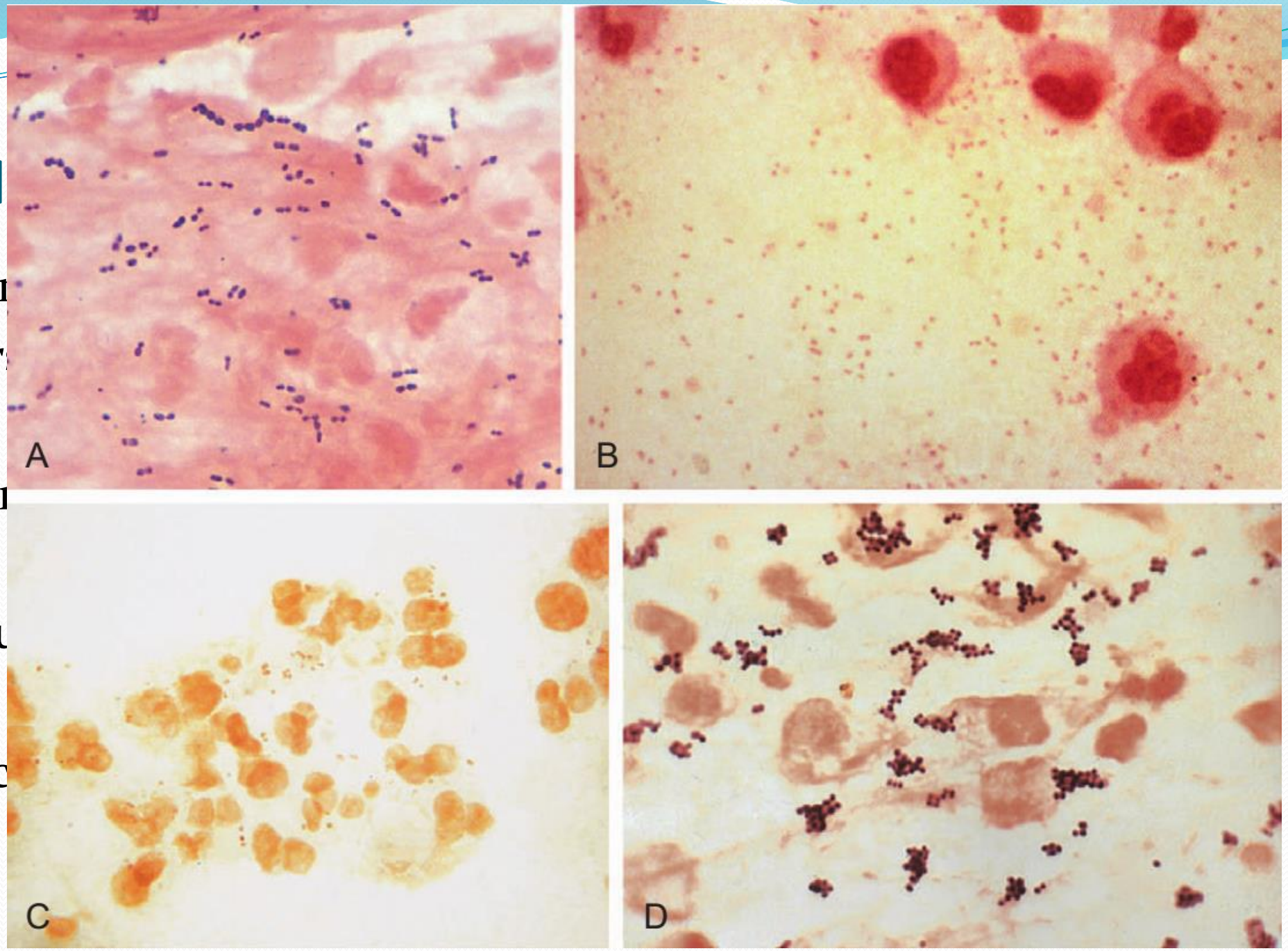

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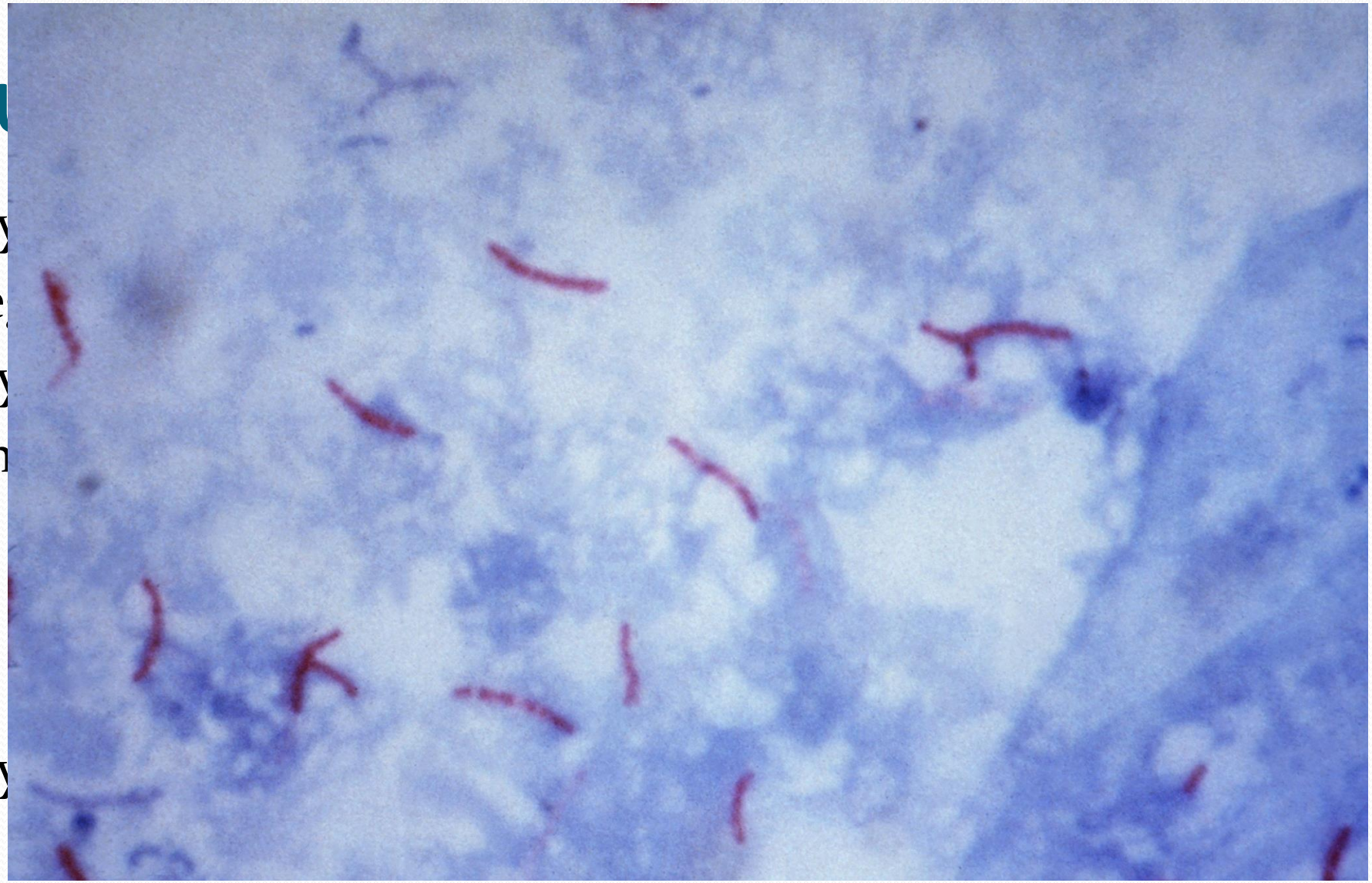
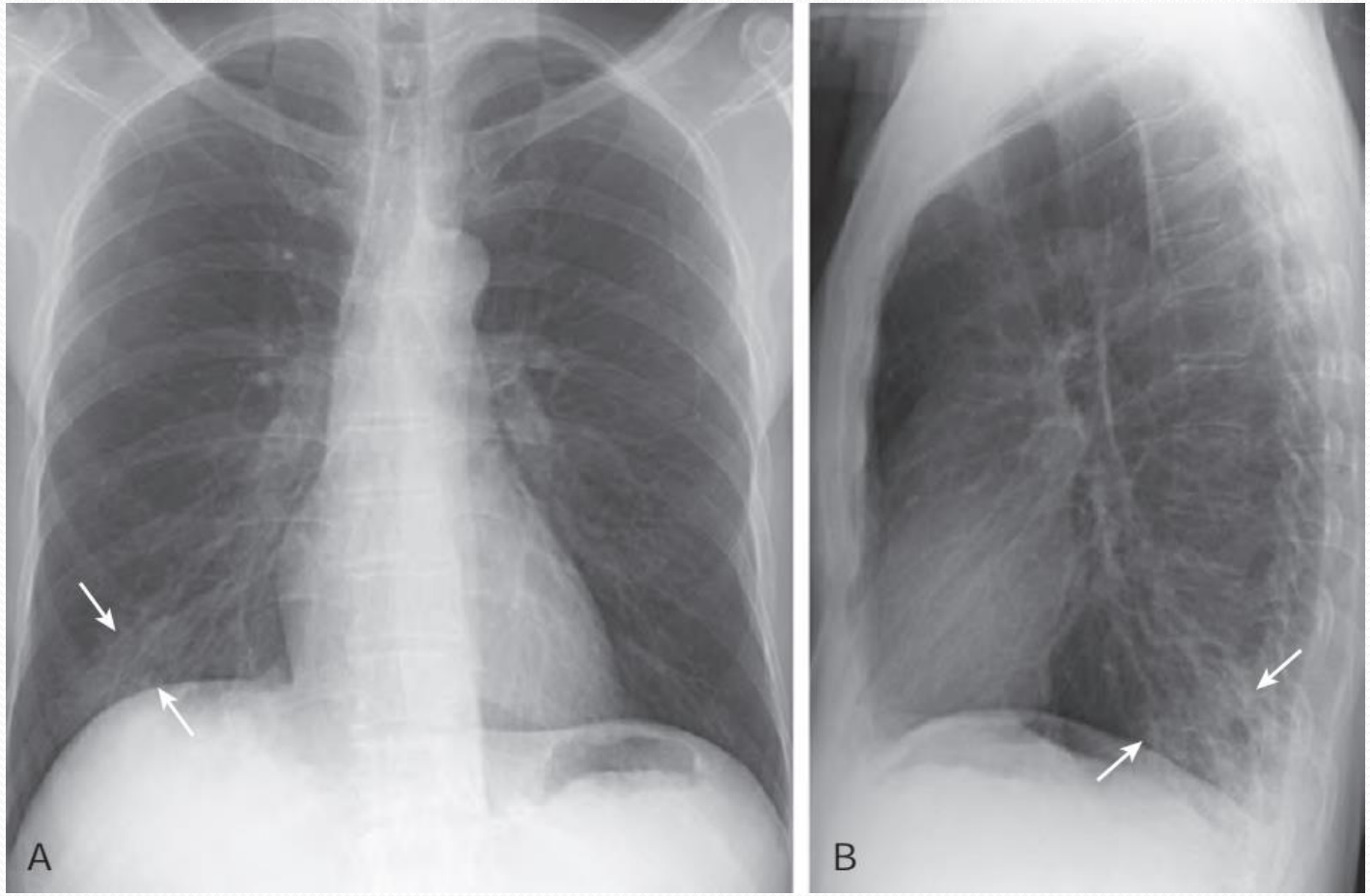
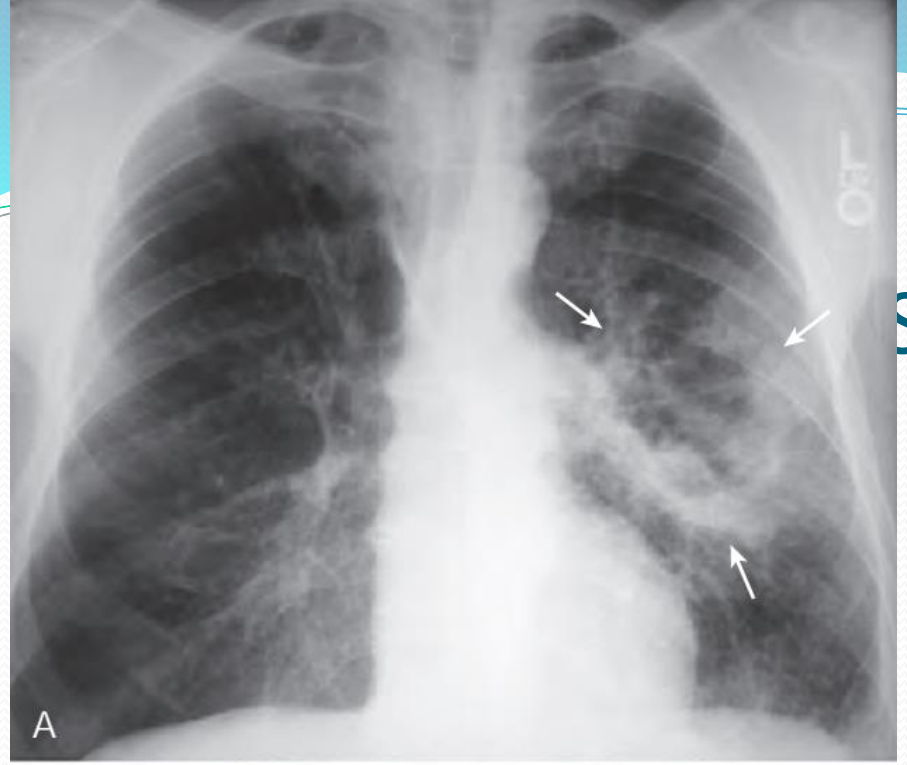
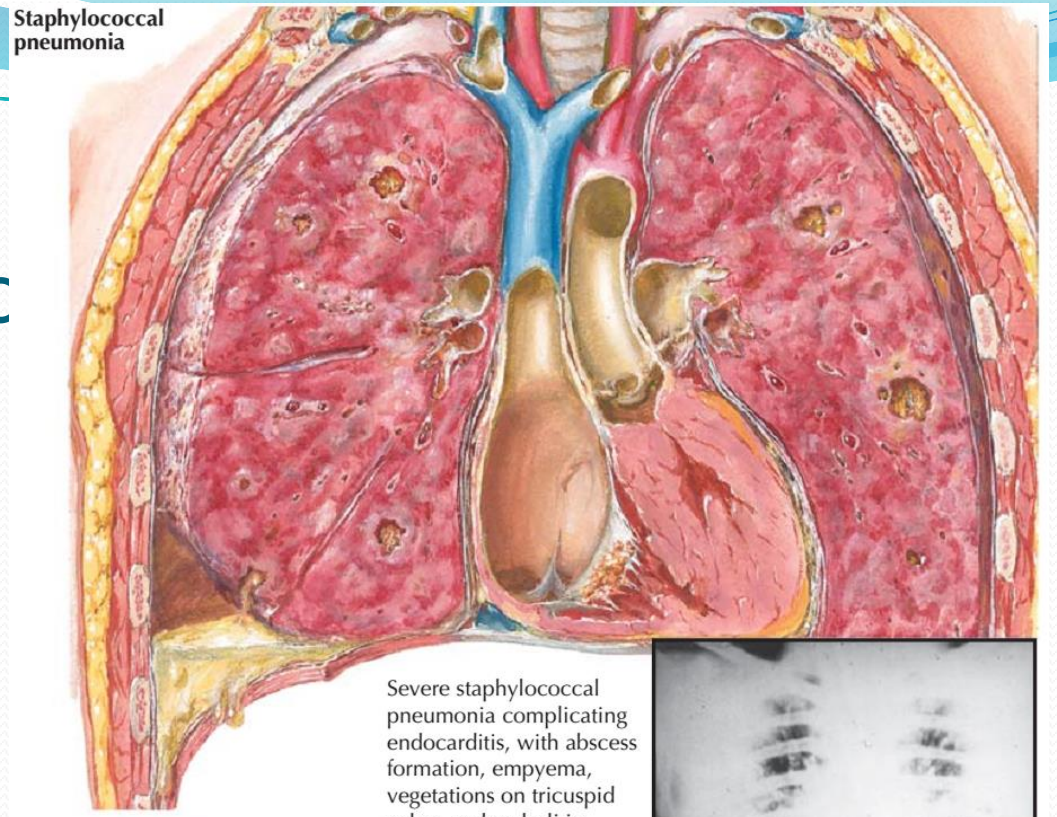


Mycoplasma pneumoniae pneumonia: unilateral bronchopneumonia



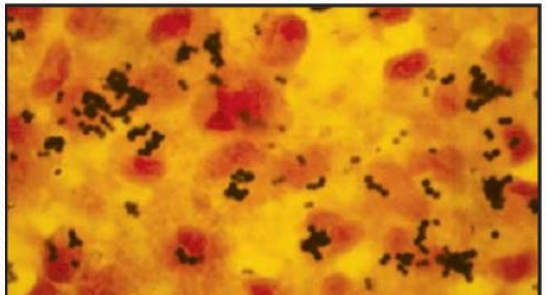
Staphyloc





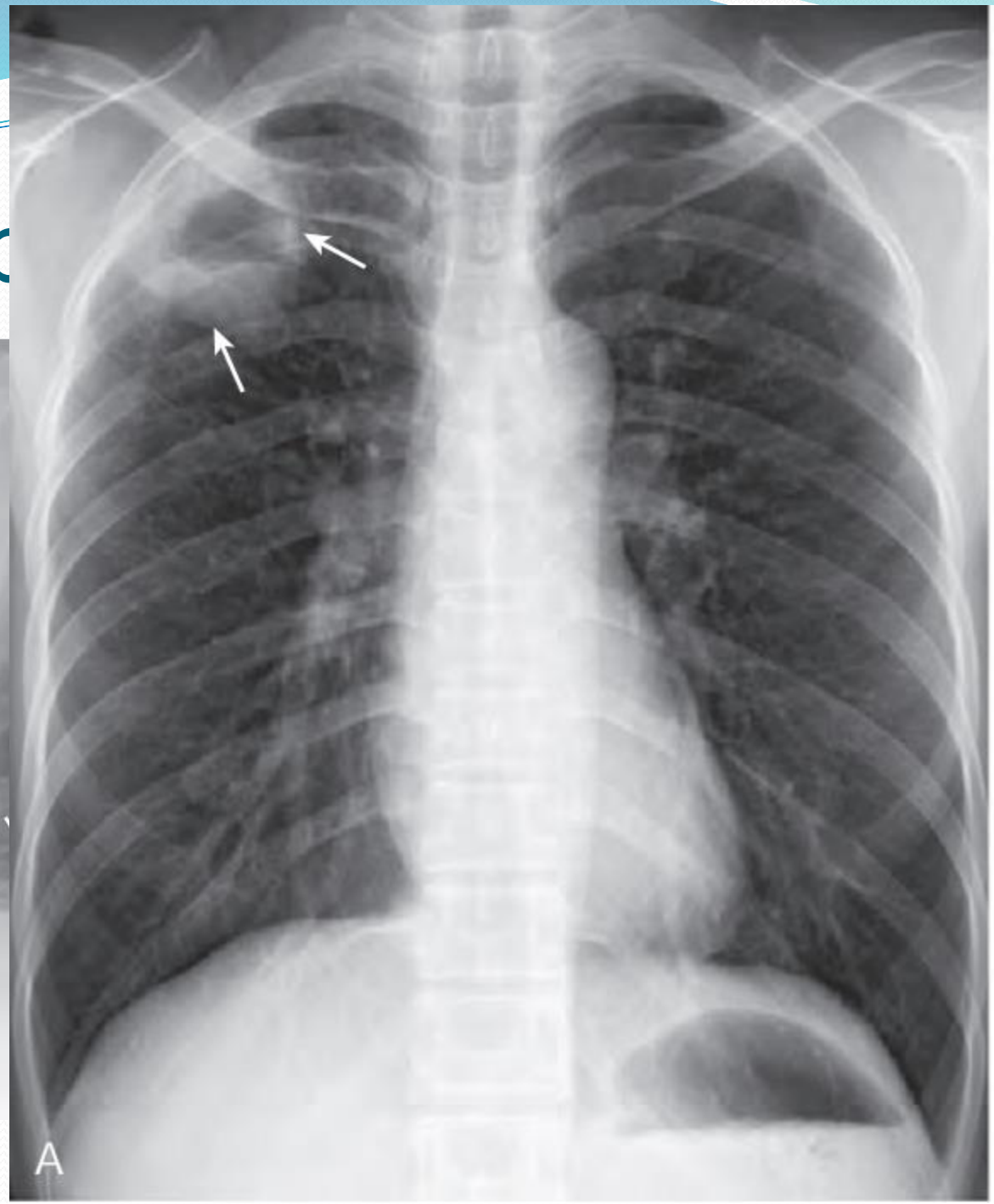
Severe staphylococcal pneumonia complicating endocarditis, with abscess formation, empyema, vegetations on tricuspid valve, and emboli in branches of pulmonary artery

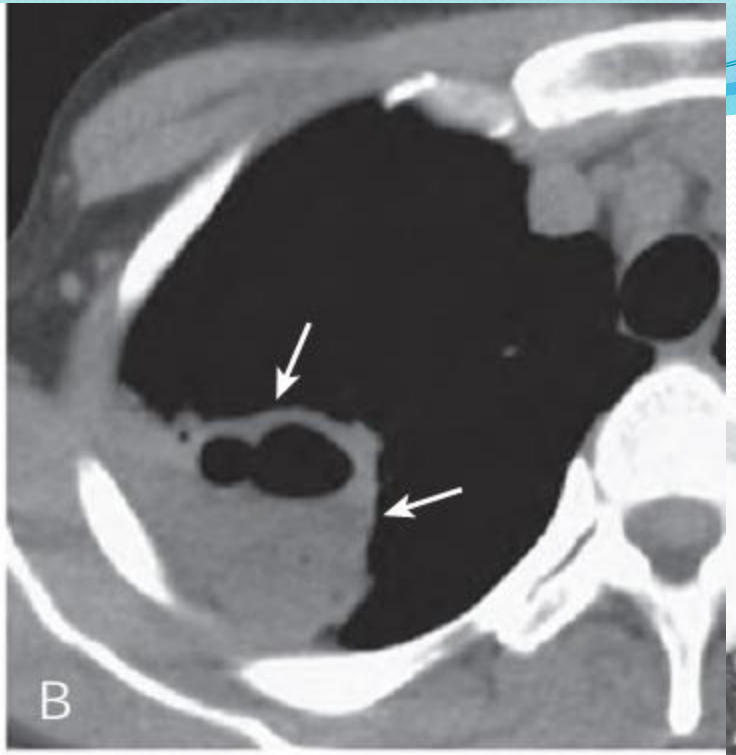
Culture showing methicillin resistance (MRSA)

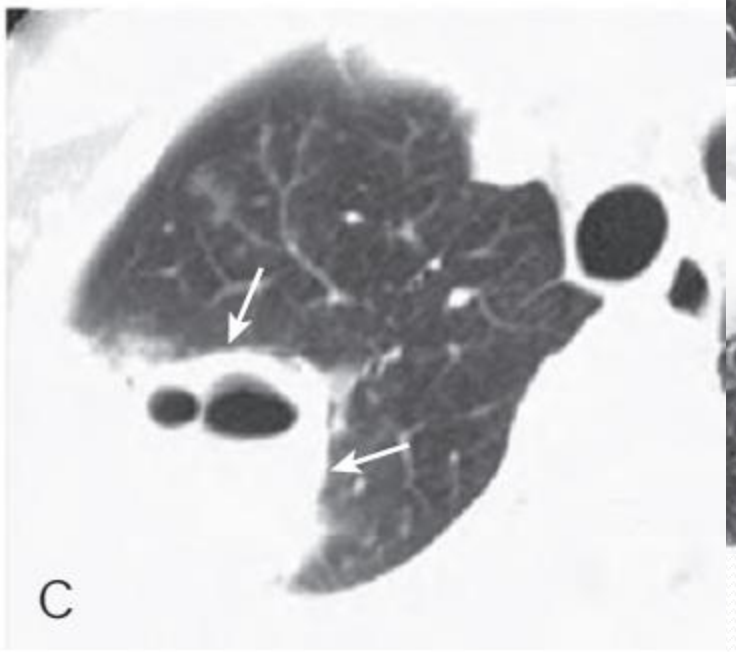


Early staphylococcal pneumonia

Kleb







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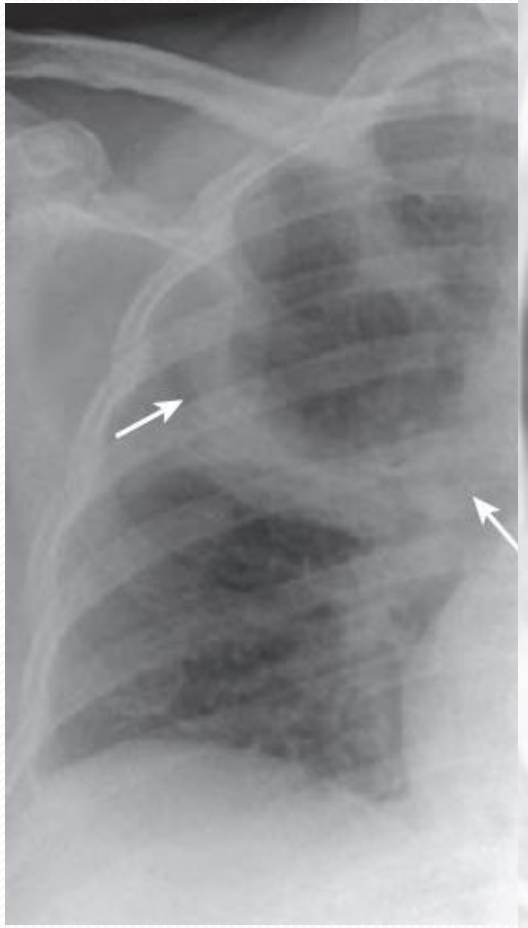
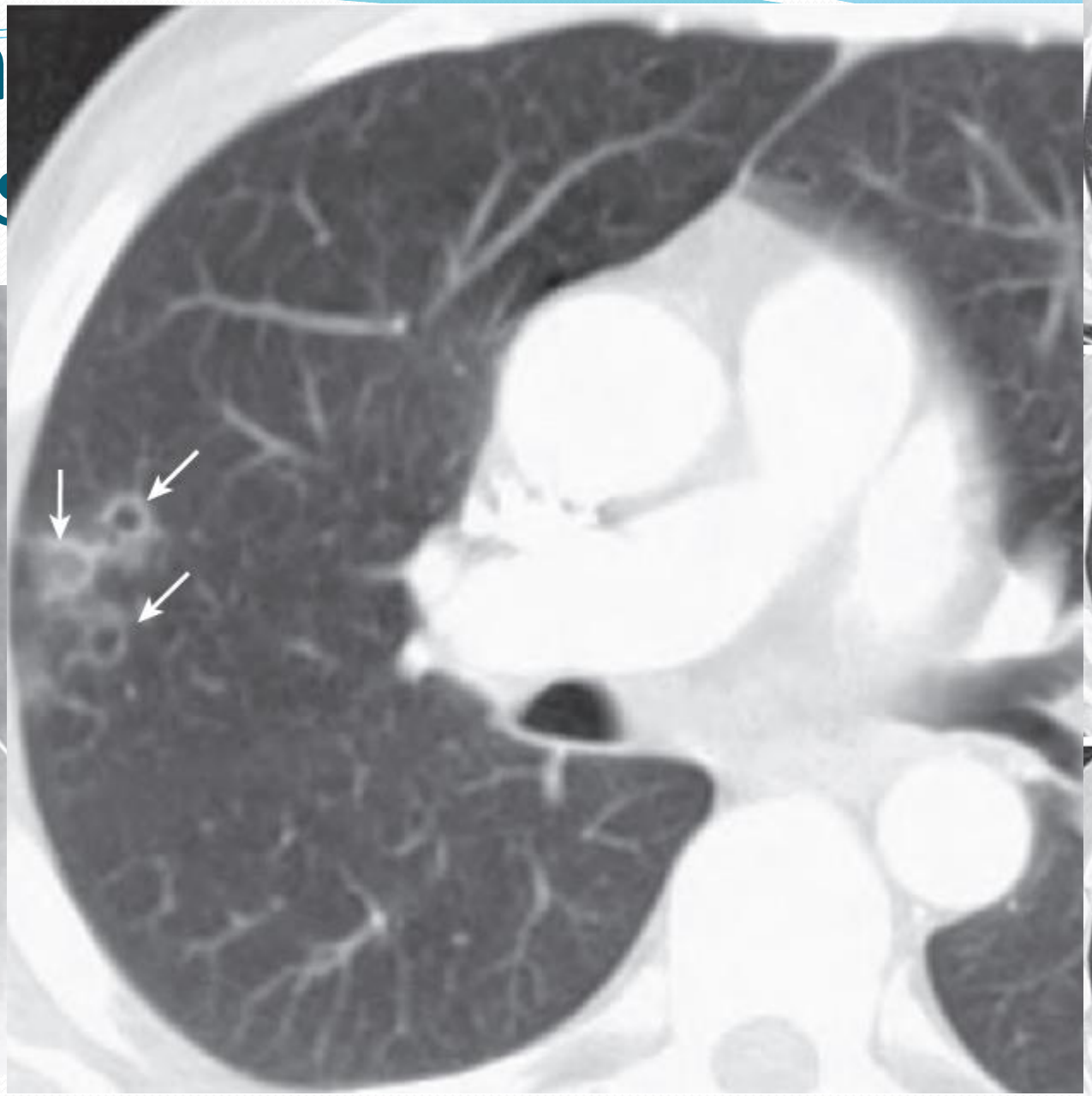
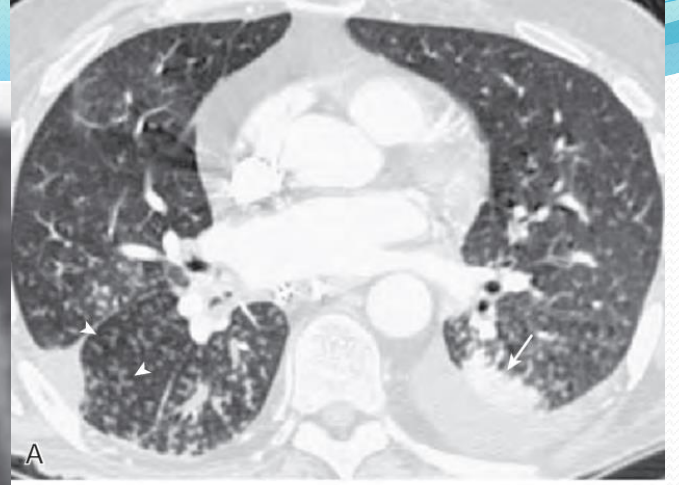
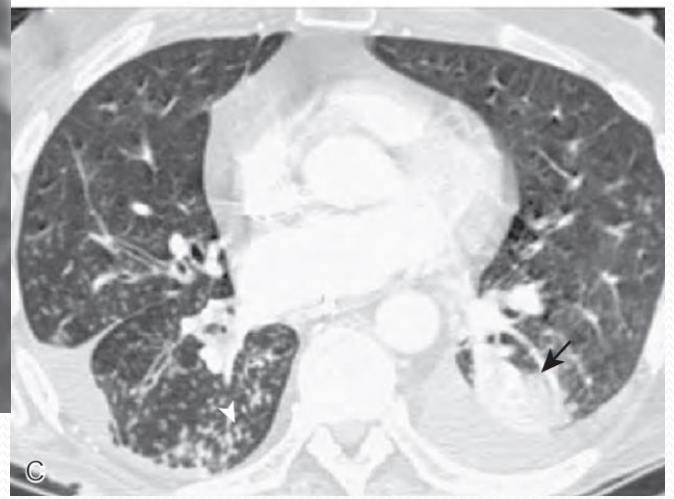
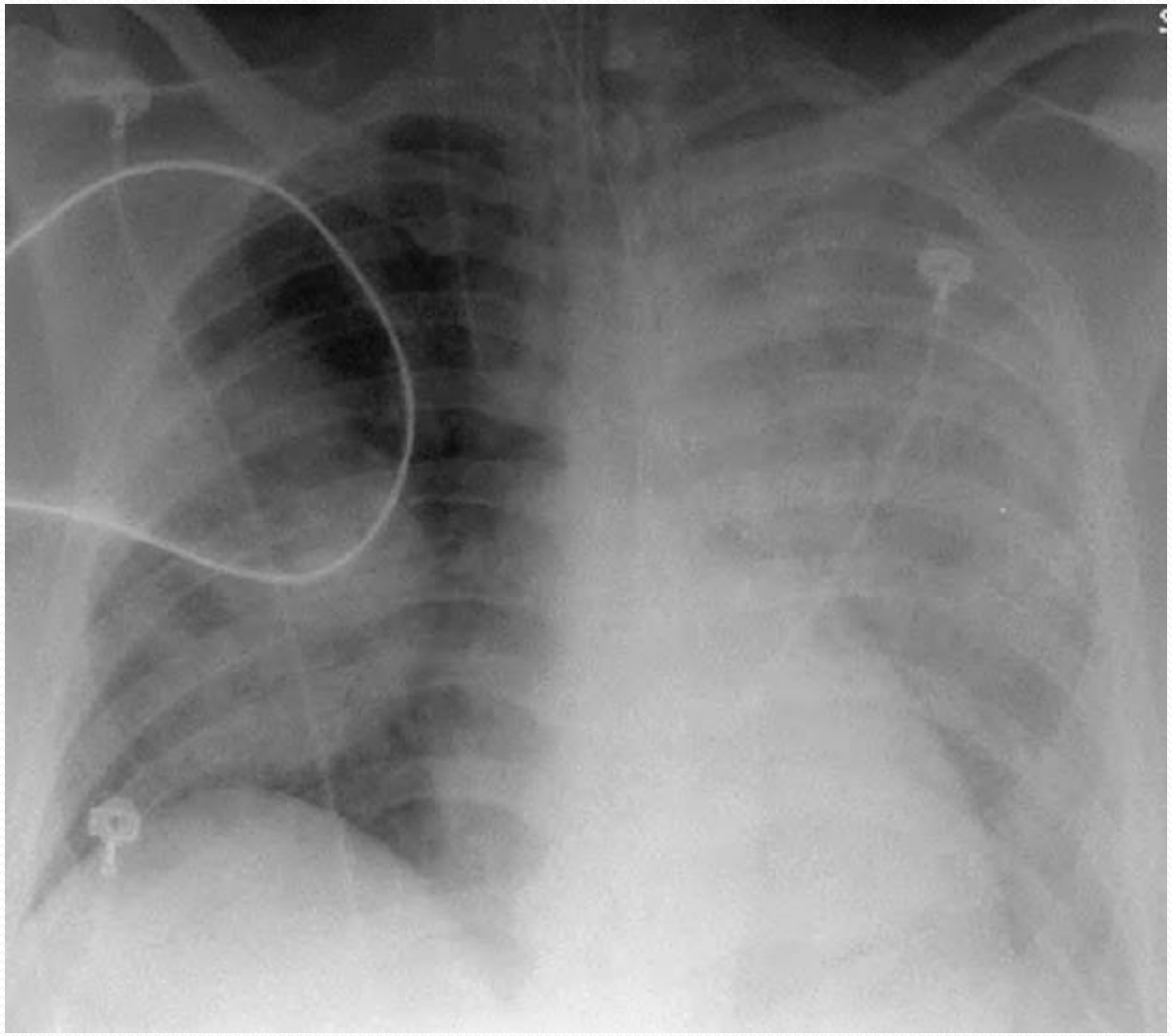








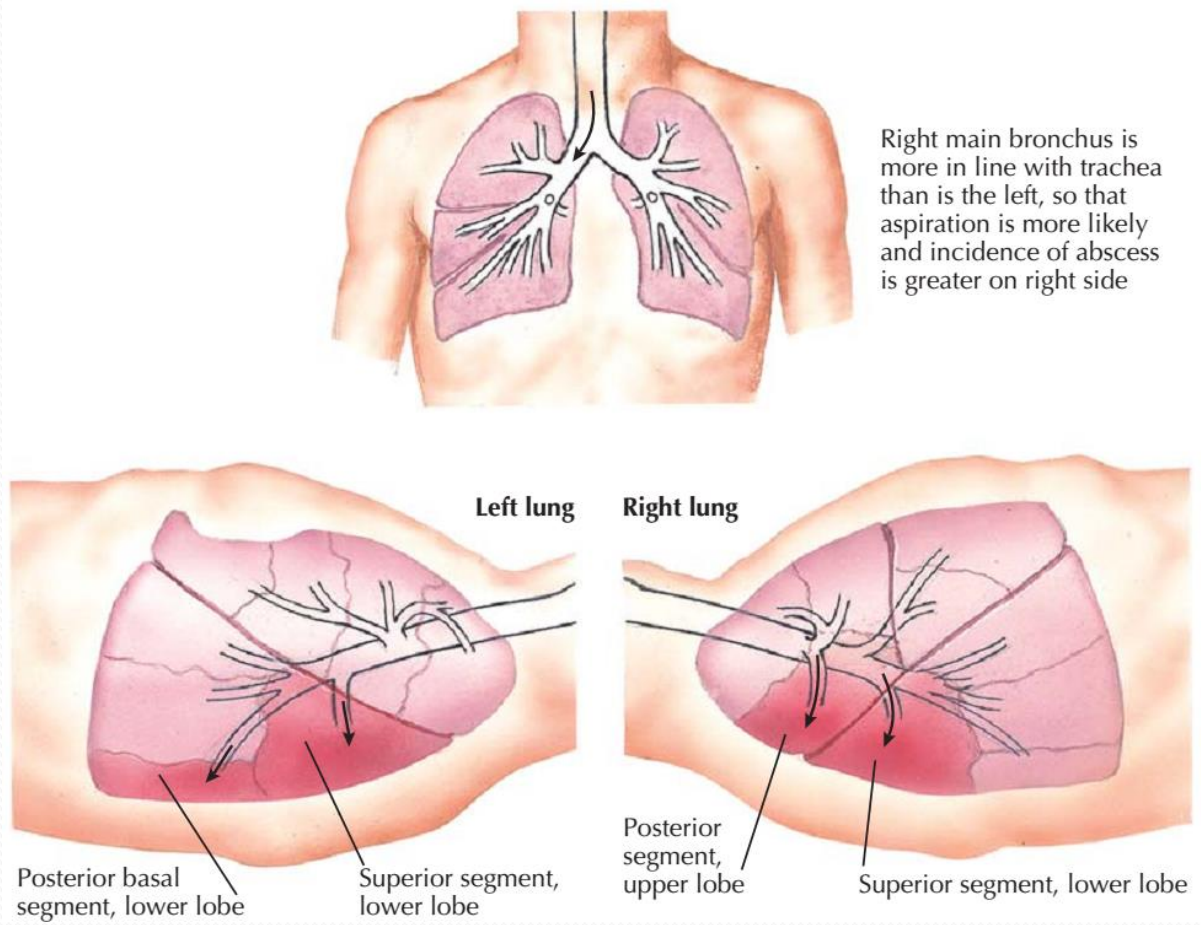
Legionella pneumophila pneumonia: multilobar pneumonia



رادیوگرافی قفسه سینه

- رادیوگرافی قفسه سینه بیماران دچار پنومونی مولتی لوبار تا هفته ۶ - ۸ اگر کاملاً پاک نشده باشد باید حداقل پیشرفت به سمت بهبود را نمایان سازد.
- انفیلترایی که تا هفته ۶ -۸پاک نشود نیازمند بررسی های بیشتری است.
- معمولاً در انفیلترایی که پاک نمی شود می بایست کانسر ریه را در نظرداشت

A.P


Right main bronchus is more in line with trachea than is the left, so that aspiration is more likely and incidence of abscess is greater on right side
Left lung
Right lung
Posterior basal segment, lower lobe
Superior segment, lower lobe
Posterior segment, upper lobe
Superior segment, lower lobe

Prevalence

- More common in children less than 4 and adults older than 60

Differential Diagnosis

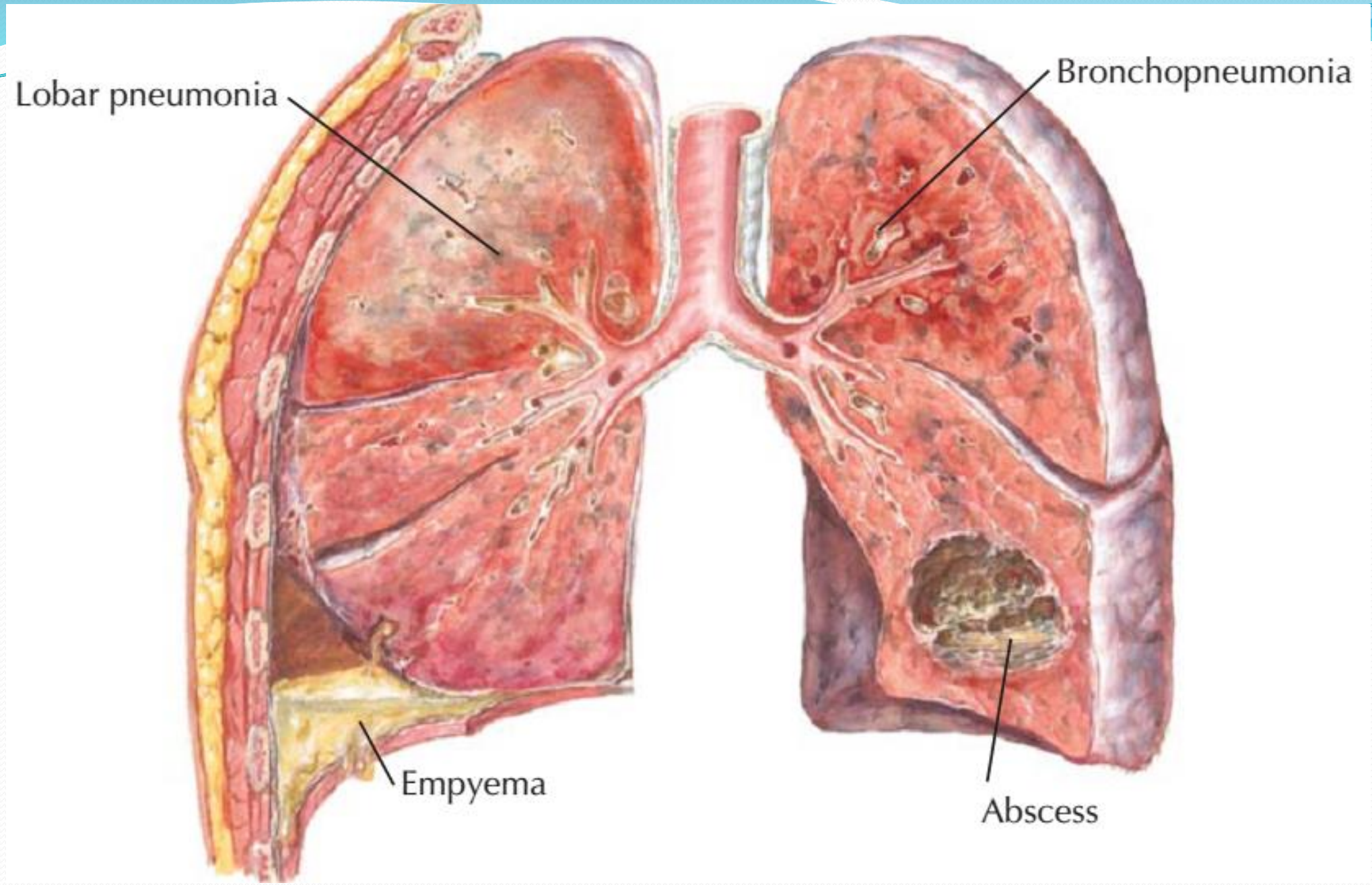
- Acute bronchitis
- COPD exacerbation

Mimic Community-Acquired Pneumonia

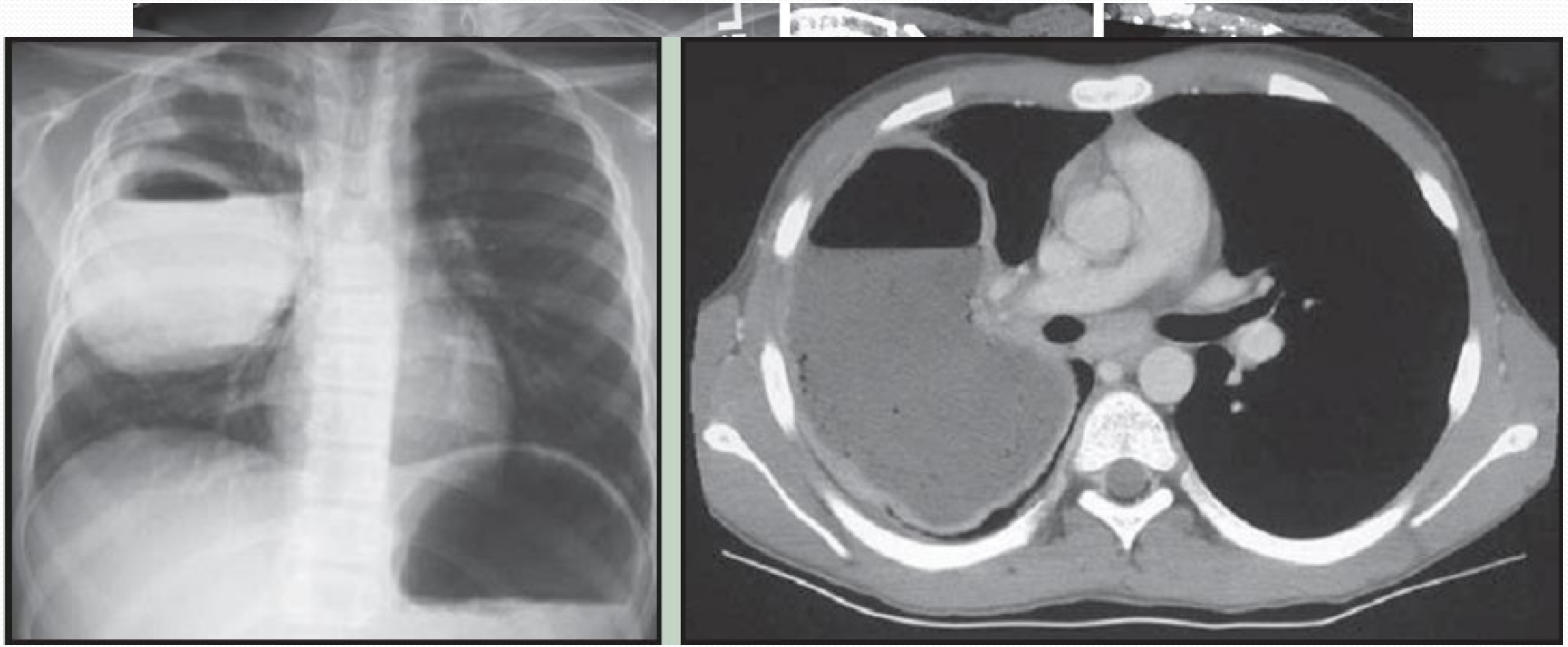
- Pulmonary edema
- Pulmonary infarction (PTE)
- ARDS
- Pulmonary hemorrhage
- Lung cancer or metastatic cancer
- Atelectasis
- Radiation pneumonitis
- Drug reactions involving the lung
- Extrinsic allergic alveolitis
- Pulmonary vasculitis (WG)
- Pulmonary eosinophilia
- Organizing pneumonia

Complications

- Metastatic infections
- Abscess formation (staph. , CA-MRSA, Pseudomona)
- Pleural effusion


Lobar pneumonia
Bronchopneumonia
Empyema
Abscess

Lung abscess

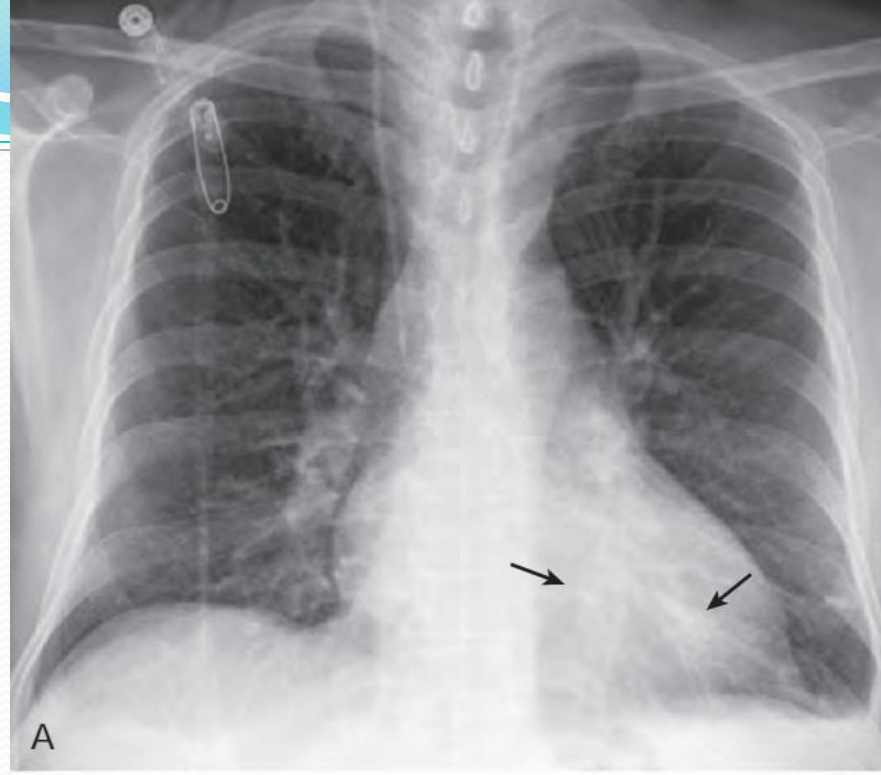


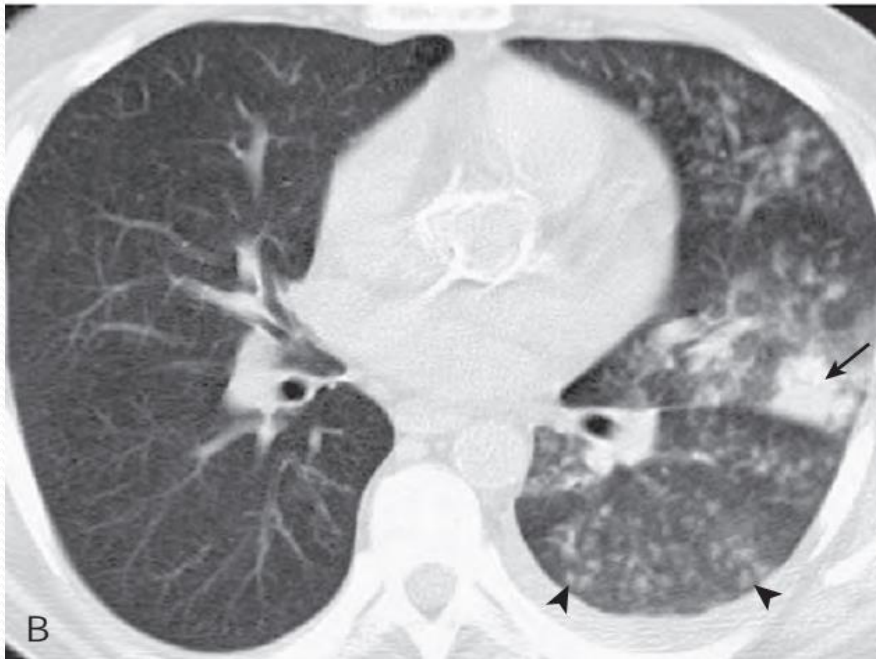
CA-MRSA, oral anaerobes, endemic fungi, M. tuberculosis, atypical mycobacteria

Pneumococcal bronchopneumonia

patchy bronchovascular thickening (arrows) in the LLL
trace blunting of the left costophrenic angle is present

B, Axial chest CT 2 days following A shows
nodular lingular consolidation (arrow)
numerous small centrilobular nodules (arrowheads)
consistent with bronchopneumonia.





OUTCOME

- Fever resolves in 2 days
- Leukocytosis resolve in 4 days
- CXR would be normal in 4-12 weeks
- Any patient should take a CXR 4-6 weeks after treatment
- If pneumonia reoccurs in same lobe a neoplasm or foreign body must be ruled out.
- If pneumonia reoccurs in different lobes an immunocompromised state must be ruled out.